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LUMBAR, RENAL, AND ASSOCIATED PARIETAL AND VISCERAL VEINS BASED UPON A STUDY OF 100 SPECIMENS

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More than four centuries ago, Leonardo da Vinci prepared sketches of the ascending lumbar vein, the segmental vessels of lumbar and azygos venous drainage, together with the inferior vena cava; however, recent commentary suggested that these dissections were probably made on the horse or cow rather than man. Andreas Vesalius' *De humani corporis fabrica libri septem*[1] pictured the inferior vena cava as a single vessel in full continuity from the pelvis to the neck, as would be found in the lower vertebrates and primates; the lumbar veins terminated in the vena cava below the origin of the renal veins. The azygos and hemiazygos systems of veins were illustrated, but not their lumborenal connections.

The anatomic account of Winslow in 1749 was indeed remarkable for the thoroughness and in the emphasis placed on anatomic variation. The intercommunications between the lumbar veins of opposite sides, in both the longitudinal and the horizontal planes, were mentioned, as well as the distribution of branches to the vertebral bodies and to lumbar musculature. Reference was similarly made to the communications which occurred between the last intercostal and the first lumbar veins. Although the probability of variation in these communications was suggested, almost two centuries passed before they were classified by Seib.

Boyer described the frequent origin of a lower lumbar vein from the iliacs and noted lumbar anastomoses with the lowest intercostal veins. Cloquet commented on the fact that dorsal rami from the ascending lumbar veins communicated with the vertebral sinuses; these segmental lumbar veins on the left were observed to be longer than those on the right. Later, Bichat described the many possible intercommunications between the lumbar veins on the ventral aspect of the vertebral bodies. Meckel limited the number of lumbar veins to three or four;

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[1]A scholarly account of the anatomical accomplishments of Leonardo can be found in O'Malley, C. D., and Saunders, J. B. de C. M., *Leonardo da Vinci on the Human Body*.

and Cruveilhier described a primary, or abdominal branch, as well as a secondary, posterior or dorsal spinal branch, from the lumbar vein. Quain described the ascending lumbar vein as a vessel "which connects more or less completely the common iliac vein, the ilio-lumbar and lumbar veins, and the azygos vein." Henle made no noteworthy addition to the already existing accounts of the lumbar venous drainage. Sappey repeated Meckel's statements, to the effect that there were only three or four lumbar veins, that they commonly entered the vena cava at right angles, and that they split into two primary divisions (as described by Cruveilhier). Hoffmann had little to add to this account. Poirier first described the valves located in the lumbar veins, which were found to be parietal and ostial, and concave on the surface facing the vena cava. Testut presented a thorough and inclusive text account of the lumbar veins, accompanied by an anatomic figure of the lumbar area in which ascending lumbar veins lay superficial to the psoas muscles, and the roots of the azygos and hemiazygos veins were ventral to the crura of the diaphragm. The origin of both ascending lumbar veins was described as the internal iliac veins near the source of the middle sacral vein, and an anastomosis over the fifth lumbar vertebra medial to the common iliac veins (rather than deep to the psoas major muscle and femoral nerve, and from the external iliac veins). Spalteholz was the first anatomist to record accurately the correct number of segmental veins as four or five. The description included all of the following elements of previous accounts: relations of the ascending lumbar vein; the arrangement of tributaries of the lumbar veins; the presence of insufficient valves; the greater length of the left lumbar veins; the cranial terminations of the ascending lumbar veins; and the occurrence of anastomoses of these veins with the renal pedicle. Piersol pictured the lumbar veins as serial homologues of the intercostal veins, and stressed the importance of the ascending lumbar vein as a collateral channel between the inferior and superior venae cavae. Rauber-Kopsch and Rouvière both described the ascending lumbar system thoroughly; Franklin, in his excellent monograph on veins, discussed the innumerable variations in terminations of the segmental lumbar veins based on a consideration of their embryologic development. Seib, after having described the embryology of the lumbar veins, made the first record of the complexities found in this venous system (in 41 dissections). The common trunks formed by the lumbar veins before entering the inferior vena cava, the frequency of anastomoses between the lumbar veins and the azygos roots were emphasized, and descriptions of unusual venous patterns were recorded, so that the stereotyped, traditional descriptions were shown to be incomplete. However, it was of interest to note that Seib made this statement, "Space will not permit a detailed inclusion of the mode of lumbar venous drainage," an appropriate omission, because his primary interest revolved about the azygos and hemiazygos systems.

The embryology of the lumbar veins is intimately associated with the development of the inferior vena cava, and the following summary is based on the work of McClure and Butler. In the human embryo of 4 millimeters, the bilateral posterior cardinal veins are developed primarily as mesonephric vessels which anastomose with the subcardinal veins. This venous plan has been termed by Huntington and McClure as the "cardinosubcardinal stage." It is common to the Sauropsida and Mammalia, and is the general plan of the venous system in the human until the 10 millimeter stage.

The critical change which has occurred in the 11 millimeter human embryo is the union, through the caval mesentery, of the hepatic sinusoids and the right subcardinal vein (a communication which ultimately forms the hepatosubcardinal junction). As McClure and Butler have pointed out, the result is the appearance of the prerenal segment of the inferior vena cava formed from

the vena hepatica communis of Hochsteter, the hepatic sinusoids, and a portion of the right subcardinal vein. The intersubcardinal anastomosis is encountered at this stage; the connection is important because if forms a channel by which the blood becomes directed away from the left side of the body, and is returned to the heart in part by a route other than the posterior cardinal veins. The permanent kidneys (metanephroi) have made their appearance at this stage; their presence causes an abrupt angulation in the posterior cardinal veins. This segment of the posterior cardinal vein (especially the left one), in lateral relationship to the metanephros, undergoes marked changes, along with the formation of the supracardinal veins and establishment of the postrenal division of the inferior vena cava.

A series of changes occurs in the 15 millimeter stage, which marks the formation of the postrenal division of the inferior vena cava (pars renalis and supracardinalis). At this time the blood stream is diverted from the posterior cardinal veins to the prerenal division of the inferior vena cava, a change which is concurrent with the appearance of a new pair of vessels, the supracardinal veins. The right posterior cardinal vein undergoes atrophy. In the lumbar region the supracardinal veins are present bilaterally, and are of approximately equal caliber; prominent anastomoses occur between the posterior cardinal and supracardinal veins. Occurring with the formation of the supracardinal veins in the lumbar region is the subcardinal-supracardinal anastomosis, which contributes bilaterally to the formation of an embryonic renal collar. The right and left posterior cardinal veins have almost disappeared in the human embryo of the 15 millimeter stage.

In the 22 millimeter embryo the adult condition exists. Perhaps the most important single feature is the circumaortic venous ring, or "renal collar." The postrenal portion of the inferior vena cava on the right has increased greatly in size, as compared to its partner on the left side. The ventral boundary of the renal ring is formed by the caudal end of the pars subcardinalis of the inferior vena cava, and by the intersubcardinal anastomosis; the lateral boundary, by the right and left subcardinal-supracardinal anastomosis; the dorsal margin, by the supracardinal veins. The left renal collar is eventually lost, so that blood is shunted to the prerenal section of the inferior vena cava through the right renal collar. The metanephroi have migrated cranially, and the future renal veins have been formed. It is significant that, with the exception of the presence of the left inferior vena cava, the arrangements of the venous patterns are for all practical purposes the same as those seen in the adult human.

Seib and Franklin have presented the most concise and thorough account of the embryology of the lumbar veins. According to these authors, the segmental venous arrangements of the lumbar region is fundamentally similar to that of the thorax, having as its origin a series of branches of the posterior cardinal veins. The right and left segmental veins become joined to each other by a transverse vessel which courses dorsal to the aorta, as contrasted with the relatively minor transverse communications which survive in the azygos system. As the supracardinal vein supplants the posterior cardinal-subcardinal stage, a connection is formed between the supracardinal vein and the intersegmental ones. This connection may be a medial sympathetic-supracardinal anastomosis, so named because it connects with the intersegmental vein in the region of the medial sympathetic line. In addition to this communication, there may be a lateral connection between the supracardinal and the individual lumbar vein. It is to be noted that if each connection with the supracardinal persists, the lumbar veins may empty individually into the adult inferior vena cava. However, if the medial sympathetic-supracardinal junction persists, both lumbar veins will form a common trunk with the inferior vena cava.

Gladstone described the ascending lum-

bar vein in the 19 millimeter human embryo as connecting the lumbar veins and running in a longitudinal direction in front of the lumbar transverse processes, and under cover of the psoas major muscle. Gladstone also referred to the ascending lumbar vein as the precostal vein, being dorsolateral to the sympathetic ganglia and to the veins in the azygos and hemiazygos lines. Seib suggested the term lumbocostal vein instead of precostal, because the ascending lumbar vein in the embryo has a thoracic and lumbar segment. The former channel frequently persists in the adult as an isolated longitudinal venous segment; it represents thoracic remnants of the lumbocostal, rather than the thoracolumbar vein.

The lateral roots of origin of the azygos and hemiazygos veins are made up of the juncture of the ascending lumbar vein and the twelfth intercostal (or subcostal) vein, whose embryonic origin is similar to that of other intercostal veins.

Huntington and McClure stated that the azygos and hemiazygos veins were derived from the thoracic portion of the supracardinal (or paraureteric) veins, whereas the inferior vena cava originated from the lumbar segment of the right supracardinal vein. However, Reagan called attention to the fact that the inferior vena cava lies ventrolateral to the sympathetic chain. Reagan concluded that the supracardinal vein of Huntington and McClure is a composite vessel, consisting of a thoracic segment derived from the medial sympathetic vein, and a lumbar portion (located in the thoracolumbar line) derived from the paraureteric or supracardinal vein. The more caudal portions of the left and right medial sympathetic veins are absorbed by the respective paraureteric vessels. Retention of various portions of the medial sympathetic veins accounts for the presence in the adult of the intermediate azygos and hemiazygos roots.

The medial roots of the azygos and hemiazygos veins are derived from one or the other subcentral veins, which in the embryo are dorsal to the aorta, dorsomedial to the lumbar and intercostal arteries, as compared to the medial sympathetic veins; it should be noted that both sets of these embryonic veins are ventromedial to the sympathetic trunks.

According to Seib, the left inferior vena cava is typically derived from the left paraureteric or supracardinal vein, although it is also possible for this structure to take origin from the lumbar portion of the left medial sympathetic vein. The persistent left inferior vena cava is said to be derived from the former vein if it lies ventrolateral to the lumbar arteries and to the rami of the sympathetic trunk, and from the latter if it lies dorsomedial to the sympathetic fibers but ventrolateral to the lumbar arteries. Seib has similarly pointed out that if the intermediate hemiazygos root takes origin from the posterior aspect of a persistent left inferior vena cava, the latter vessel probably was derived from the left paraureteric vein. Contrariwise, if the intermediate hemiazygos root drains into the left renal vein, the persistent left inferior vena cava would represent the left lumbar medial sympathetic vein. If the left internal spermatic vein drains into a persistent left inferior vena cava, the latter vessel probably took origin from the left paraureteric vein; should the left sex vein drain into the left renal vein to the left of the junction with the persistent vena cava into the renal, the relationship would indicate that the left caval vein was derived from the left medial sympathetic vein.

The retroaortic renocaval arch is a vein which courses obliquely and caudally toward the midline behind the aorta, from the left renal vein; it ends in the inferior vena cava. Such an arch may be associated with a normal left renal vein, in which case it is called a circumaortic venous ring; in those instances in which the normal left renal vein is absent, it is termed a retroaortic renal vein (Seib). The circumaortic venous ring, known also as the "renal collar," is formed ventrally by the left renal vein, dorsally by the retroaortic renocaval arch, and medially by the right inferior vena cava

(the latter joining the openings of the two vessels). The retroaortic renal vein crosses dorsal to the aorta to reach the inferior vena cava; thus, there is a marked similarity between the retroaortic renocaval arch and the retroaortic renal vein. Seib has suggested that because of the oblique course of the retroaortic renal vein (in contrast to the horizontal course of the left renal vein), there has been a failure in the development of the ventral limb of the circumaortic venous ring, only the dorsal limb remaining in the adult.

MATERIALS AND METHODS

The present observations were made on the authors' dissections in a series of 100 adult cadavers from the Anatomical Laboratories at the Northwestern University Medical School between the years 1947 and 1955. Most specimens were from white males.

The abdominal contents were removed, as well as the diaphragm and the lower 5 or 6 ribs, which facilitated a proper dissection of the azygos and hemiazygos roots. The psoas major muscle was dissected from the centra and transverse processes of the lumbar vertebrae, so that the origin of the lumbar veins could be recorded. Complete dissection of the ascending lumbar vein was carried out in 81 cadavers, but the origin and termination of this vessel were examined in the entire lot of 100 specimens.

An effort was made to employ a uniform terminology for the veins in the renal and lumbar areas. Blood flow was regarded as cranialward; thus the origin of a vein referred to its distal beginning, and the termination to its more proximal end. Some lumbar veins, of course, descended several segments before making a caval termination; however, in these instances it was assumed for the sake of uniformity that the origin of the lumbar vein was in the ascending lumbar vein. The terminology of Seib was utilized for both the adult and embryonic veins of this area; this scheme was useful in naming the roots of origin of the azygos and hemiazygos veins.

With the exception of Figure 6a, which was borrowed directly from Franklin, the illustrations were prepared from actual laboratory dissections.

OBSERVATIONS

The lumbar system of veins was divided into the following components: (1) the lumbar segmental veins; (2) the prevertebral veins, which were ventral to the lumbar vertebrae, dorsal to the aorta and the inferior vena cava, and included the roots of origin of the azygos and hemiazygos veins; (3) ascending lumbar veins, which passed from the iliac vein to the subcostal beneath the psoas major muscle, and were placed on the transverse processes of the lumbar vertebrae. A fourth group of vessels in the lumbar area included persistent left inferior venae cavae (3 specimens), circumaortic venous rings (6 examples), and retroaortic renal veins (2 cases). These vessels were important because of their anatomic relationship to the lumbar veins.

LUMBAR SEGMENTAL VEINS

The lumbar segmental veins were comparable to the vessels of the intercostal venous drainage; usually there were right and left veins at each lumbar level, and in general there were 5 such veins on each side.[2] Typically, they were situated dorsomedially in relation to the psoas major muscle, covered by a tough investing fascia of the muscle, and rested on the lumbar vertebral body. The segmental lumbar veins arose from the ascending lumbar vein, coursed over the body of the vertebra in a ventromedial direction, and emerged from beneath the medial border of the psoas major muscle on their way to termination in the inferior vena cava. The lumbar veins lay dorsal to the sympathetic trunk and its medially directed filaments.

[2]It should be explained that the lumbar veins were considered to be multiple at one level only when they remained separate vessels throughout their course from the ascending lumbar vein to their termination. When a single segmental lumbar vein bifurcated in its course, the larger of the two branches was considered the termination of the vessel. It was interesting to note that there was no case in which 3 lumbar veins were present on one side at a single vertebral level.

TABLE I.—TABULATION OF THE PRESENCE, ABSENCE, OR DOUBLING OF THE LUMBAR SEGMENTAL VEINS

		Vertebral levels				
		1	*2*	*3*	*4*	*5*
Absent	Left	2	1	—	1	28
	Right	6	4	—	4	37
Single	Left	87	98	94	95	70
	Right	85	95	95	89	62
Double	Left	11	1	6	4	2
	Right	9	1	5	7	1

A lumbar vein was considered to be double if two such veins were present at both origin and termination.

TABLE II.—CLASSIFICATION OF LUMBAR SEGMENTAL VEINS

		Vertebral levels				
		1	*2*	*3*	*4*	*5*
Vena cava	Left	2	10	33	65	4
	Right	6	58	46	66	9
Other vessels or structures	Left	97	54	19	8	70
	Right	87	19	9	7	55
Common trunks	Left	10	36	54	30	—
	Right	10	20	50	30	—

This classification was on the basis of entrance of the veins into, (1) inferior vena cava directly, (2) termination in structures or vessels other than the inferior vena cava, (3) communication with another segmental lumbar vein to form a common trunk with usual termination in the inferior vena cava.

TABLE III.—CLASSIFICATION OF SEGMENTAL LUMBAR VEINS ON THE BASIS OF POINT OF ENTRANCE INTO THE INFERIOR VENA CAVA

		Vertebral levels				
		1	*2*	*3*	*4*	*5*
Same level	Left	1	5	22	59	3
	Right	2	35	38	64	9
Inferior level	Left	1	5	11	6	—
	Right	4	23	8	1	—
Superior level	Left	—	—	—	—	1
	Right	—	—	—	1	—

The lumbar vein must enter the vena cava directly to be included in this table.

Actually, irregular patterns were common; these varied from total absence of the lumbar vein, to a complex formation of common trunks to which 3 or more veins contributed. The fifth lumbar vein was most frequently absent (28 left, 37 right). In such instances, the ascending lumbar vein terminated in the common iliac vein over the body of this vertebra. It was interesting to note that segmental lumbar veins were absent at the first, second, and fourth lumbar levels in approximately the same number of specimens (Table I), and that this circumstance failed to occur at the third lumbar level. Presence of a single intersegmental lumbar vein for each level was found to be the rule; however, doubling of these structures occurred at the level of the first lumbar vertebra in 20 specimens, of the second lumbar in 2, of the third lumbar in 11 cases, of the fourth lumbar in 11 specimens, and of the fifth lumbar in 3 instances (Table I).

The lumbar segmental veins reached their termination in four different ways: (1) separately and with independent entry into the inferior vena cava; (2) as separate vessels which entered venous channels other than the vena cava, but in the lumbar and renal areas; (3) as channels which terminated in nonvascular structures such as bone, intervertebral disc, and prevertebral connective tissue; (4) lastly, as 2, 3, or 4 segmental lumbar veins which, after having joined one another, reached the inferior vena cava as a common trunk (Table II).

The segmental lumbar veins displayed a limited number of variations near their origin from the ascending lumbar vein. However, after having emerged from beneath the anterior border of the psoas major muscle, variation seemed to be the rule.

Dissection showed that the first and fifth segmental lumbar veins drained into the inferior vena cava only in 8 and 13 instances, respectively, and there was the possibility of 200 segmental veins at each lumbar interspace in a total of 100 dissections (Table II). The fourth lumbar vein, followed by the third, were the most frequent direct caval tributaries, with approximately the same number of veins on each side which made this particular termination. At the second lumbar level there was a striking discrepancy between termination of the veins of the two sides; there were only 10 examples in

which the left segmental vein emptied into the cava, whereas the right followed this particular pattern in 58 instances.

The frequency of entrance of the segmental lumbar vein directly into the vena cava at the same or a different vertebral level was recorded in Table III. It was found that in only 2 instances had a segmental vein ascended to empty into the vena cava; approximately one-third of the veins at the second lumbar interspace passed to an inferior vertebral level before emptying into the cava (Fig. 1b); at the third lumbar interspace this frequency was reduced to 19 in a total of 79 veins present. It was interesting to note that, with the exception of 9 instances, all veins present at the fourth and fifth lumbar levels which entered the inferior vena cava directly, did so at the same level.

The second, third, and fourth lumbar levels were the most frequent sites of formation for common trunks that subsequently entered the vena cava (Table II). Formation of a common trunk at the fifth lumbar level failed to occur in this series, and was found only 20 times at the first lumbar. Further consideration of these trunks formed by 2 lumbar segmental veins, which then emptied into the cava, showed that this circumstance occurred most frequently at the third and fourth lumbar levels on the left; in those instances in which the segmental veins were paired at the same level, one vein passed to the right and the other to the left of the vertebral column (Table VI). The formation of a common trunk of caval termination occurred in 18 cases when formed by 2 lumbar segmental veins of the same side and of adjacent vertebral level; 12 of these examples were on the left and were formed by the second and third lumbar veins. There were only 6 instances of common trunks formed by lumbar veins, neither of the matching side nor of the same vertebral level. All of these occurred between the second lumbar on the left and third lumbar veins on the right side. There were 26 examples of common trunks formed by 3 or more segmental lumbar veins, 20 of which emptied into the

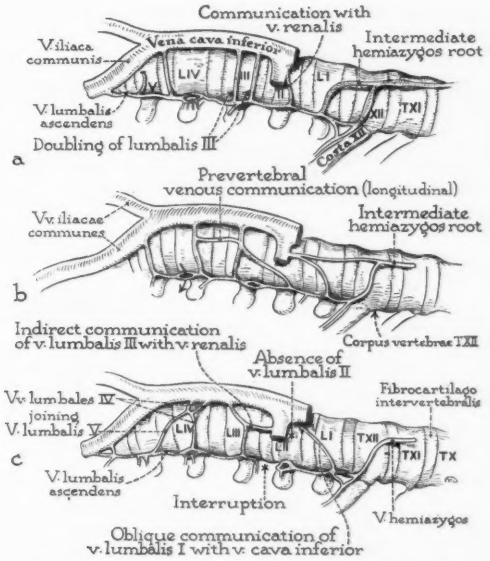

FIG. 1. Paravertebral dissection in which the psoas major muscle, crus of the diaphragm, and left kidney have been removed. This type of exposure revealed the rather extensive anastomotic venous channels which paralleled the inferior vena cava. a, At the third lumbar level, doubling of the lumbar veins was seen; over the second lumbar vertebra, the segmental vein emptied into the left renal vein, and at the first lumbar level found termination in the intermediate hemiazygos root, which was not an uncommon occurrence. b, A perineural ring was seen in this specimen (arrow), formed by a hiatus in the ascending lumbar vein. It was not unusual for lumbar veins to pass to an inferior level, where they emptied into another lumbar vein or other vascular channels. A prevertebral longitudinal connecting vein was seen at the third and fourth lumbar level. c, The lumbar vein at the second lumbar level was absent, and an interruption in the left ascending lumbar vein was present at this segment. The first lumbar vein on the left side of the specimen found termination in the inferior vena cava, which was a frequent occurrence. The fourth and fifth lumbar veins formed a common trunk to enter the inferior vena cava.

inferior vena cava opposite the third lumbar vertebra; Table VI demonstrated that the third lumbar vein on the right and left was the most frequent contributor to these common trunks of 3 or 4 veins. No common lumbar trunks with caval termination were made up of more than 4 lumbar segmental veins.

The lumbar veins remained separate from one another and entered venous channels other than the inferior vena cava, or they

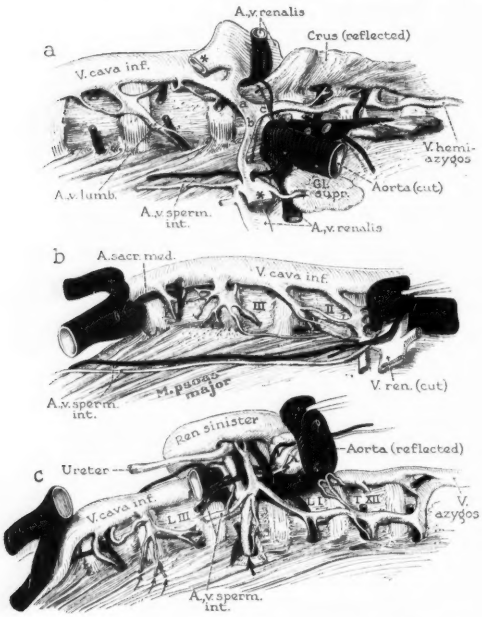

FIG. 2. Lumborenal dissections, with the psoas major muscle intact, but with the diaphragm reflected or removed. In each specimen, a segment of the abdominal aorta has been removed, the cut ends retracted to expose the lumbar, renal, and hemiazygos veins, and certain of the caval communications. a, In this dissection the psoas muscle has been left intact, and the lumbar paravertebral drainage was represented by single lumbar veins. At the level of the left kidney, the ventral limb of a circumaortic venous ring (cut ends marked by **) was a large left renal vein, the dorsal limb (*a* and *b*) a much smaller retroaortic renocaval arch. The latter possessed an important communication (at *c*) with an intermediate hemiazygos root. The circumaortic venous ring has also been called the "renal collar." b, Here the left lumbar veins of the third and fourth segments received tributaries from the vertebrae and their ligaments and fibrocartilages, from the psoas major muscle and the subserous tissue, which was removed in the course of the dissection. At the second vertebral level, a large lumbar vein emerged from the psoas major muscle (at arrow) and communicated with the renal vein. The dorsal limb of a circumaortic venous ring served as an intermediary vessel at the first lumbar level. The latter vessel received small tributaries from the retroaortic structures. A large renal vein (cut) was the ventral limb of the circumaortic venous ring. c, In this specimen, as in the two preceding (a and b), the pattern of lumbar veins was irregular; one pattern at the level of the intervertebral fibrocartilage, between the third and fourth lumbar vertebrae, received tributaries from the musculature at the small arrows (reader's left), from the retroperitoneal and related tissues, and from a small vessel at deep level. At the level of the second lumbar vertebra, as was commonly true, a large lumbar vein (at the large arrow, reader's right) entered the renal vein and probably took its origin in the ascending lumbar vein, the various types of which are pictured in Figure 1, in which dissections of the psoas major muscle have been carried out. A prominent intermediate hemiazygos root was exposed by removal of the left crus of the diaphragm. This intermediate hemiazygos root brought the left renal vein into communication with the azygos system; as the hemiazygos root ascended, it received large tributaries, first lumbar and eleventh and twelfth intercostal veins.

made a nonvascular termination (Table IV). A possible 1,000 lumbar veins could have existed in this series of dissections; of this projected number, it was found that 299 segmental veins terminated directly in the inferior vena cava; another 240 lumbar veins formed common trunks before reaching the vena cava. Thus, a total of 539 lumbar veins eventually emptied into the caval channel. By way of comparison, 425 lumbar veins found their termination in vessels other than the inferior vena cava, and in nonvascular structures of the lumbar and renal area.

The first lumbar veins drained into other vessels or structures in 85 per cent of the cases (Figs. 2c and 3b), rather than into the inferior vena cava (Fig. 1c). The segmental lumbar veins of the first lumbar vertebra found a nonvascular termination in the intervertebral disc, fibrocartilage, bone, or prevertebral connective tissue with greater frequency than did those of any other level. Table IV showed an unusual and embryologically significant arrangement of the segmental veins at the first lumbar level, in which the transversely coursing veins of either side terminated in one another with no other vascular connections. The noncaval recipient of the second lumbar segmental vein was most frequently the renal vein on the left (Figs. 2c and 3b), or the azygos root on the right; the second lumbar vein drained into the left renal vein in 30 instances, and into the right renal vein in but a single instance in this series of 100 specimens.

Although the third lumbar veins most often emptied into the vena cava directly (Fig. 1a) or formed common trunks before reaching this termination (Fig. 1b and Fig. 3b), they drained into the renal veins, a left

inferior vena cava (Fig. 5c), and prevertebral tissue in some instances. The situation in which one lumbar vein was continuous in the transverse plane with another vein, was found again at the third lumbar level. Just as the third segmental lumbar vein most often found termination directly, or through a common trunk into the inferior vena cava, so the fourth lumbar vein followed this scheme. However, in a small percentage of specimens, the segmental drainage at the latter level reached the common iliac vein, or a nonvascular structure. The fifth lumbar vein terminated in the common iliac vein (Fig. 3b), rather than the inferior vena cava, in approximately 90 per cent of the specimens in which a vein was present at this level.

TABLE IV.—CLASSIFICATION OF THE LUMBAR VEINS ON THE BASIS OF THEIR TERMINATION IN VENOUS CHANNELS OTHER THAN THE VENA CAVA

		Vertebral levels				
		1	*2*	*3*	*4*	*5*
Lumbar veins	Left	9	6	2	1	—
	Right	6	1	5	—	—
Azygos roots	Left	58	11	—	—	—
	Right	67	12	1	—	—
Prevertebral plexus	Left	3	2	3	1	3
	Right	—	1	1	—	—
Retroaortic renocaval anastomosis	Left	—	4	4	—	—
	Right	1	—	—	—	—
Renal veins	Left	7	30	6	—	—
	Right	—	1	1	—	—
Nonvenous structures	Left	20	1	2	—	1
	Right	13	4	1	4	—
Left inferior vena cava	Left	—	—	2	—	—
	Right	—	—	—	—	—
Common iliac veins	Left	—	—	—	6	66
	Right	—	—	—	3	54
Hypogastric veins	Left	—	—	—	—	—
	Right	—	—	—	—	1

PREVERTEBRAL VEINS

The prevertebral veins, likewise important components of the lumbar venous system, were found coursing in a longitudinal direction in the loose areolar tissue on the ventral aspect of the lumbar vertebrae. In this classification were included the associated roots of origin of the azygos and hemiazygos veins, and a series of longitudinal veins of prevertebral location, cephalocaudad course, and discontinuity with the azygos and hemiazygos roots.[3]

The lateral roots of origin of the azygos and hemiazygos were formed by the junction of the ascending lumbar and the twelfth intercostal veins within the thoracic cavity, usually under cover of the cranial extremity of the psoas major muscle, and inferior to the head of the twelfth rib. This lateral root then passed medially and superiorly over the body of the twelfth vertebra to become the azygos (Fig. 4b) or hemiazygos vein (Fig. 3b), respectively.

The lateral azygos root (Fig. 3b) was found to be uniformly present in 50 specimens; in 1 dissection the ascending lumbar vein continued cranialward, ventral to the twelfth rib, and joined the eleventh intercostal vein to form the lateral azygos root. In 2 cases, the lateral hemiazygos root was absent; in 1 instance, the left subcostal vein was absent, and the root was considered to be an upward prolongation of the ascending lumbar vein. In a single case, an ascending lumbar vein joined the eleventh intercostal vein to form the lateral hemiazygos root. These were the only examples of cranial extension of the ascending lumbar vein (surprisingly, of bilateral occurrence).

The intermediate azygos root passed through the right crus of the diaphragm, dorsal to the inferior vena cava, ventrolateral to the lumbar arteries, and dorsomedial to the sympathetic trunk. There were 17 examples of intermediate azygos root in the present series, 8 of which originated in the inferior vena cava, 4 over an intervertebral disc, and the remaining 5 in the first or

[3]The azygos and hemiazygos roots were grouped and classified in accordance with the schema of Seib.

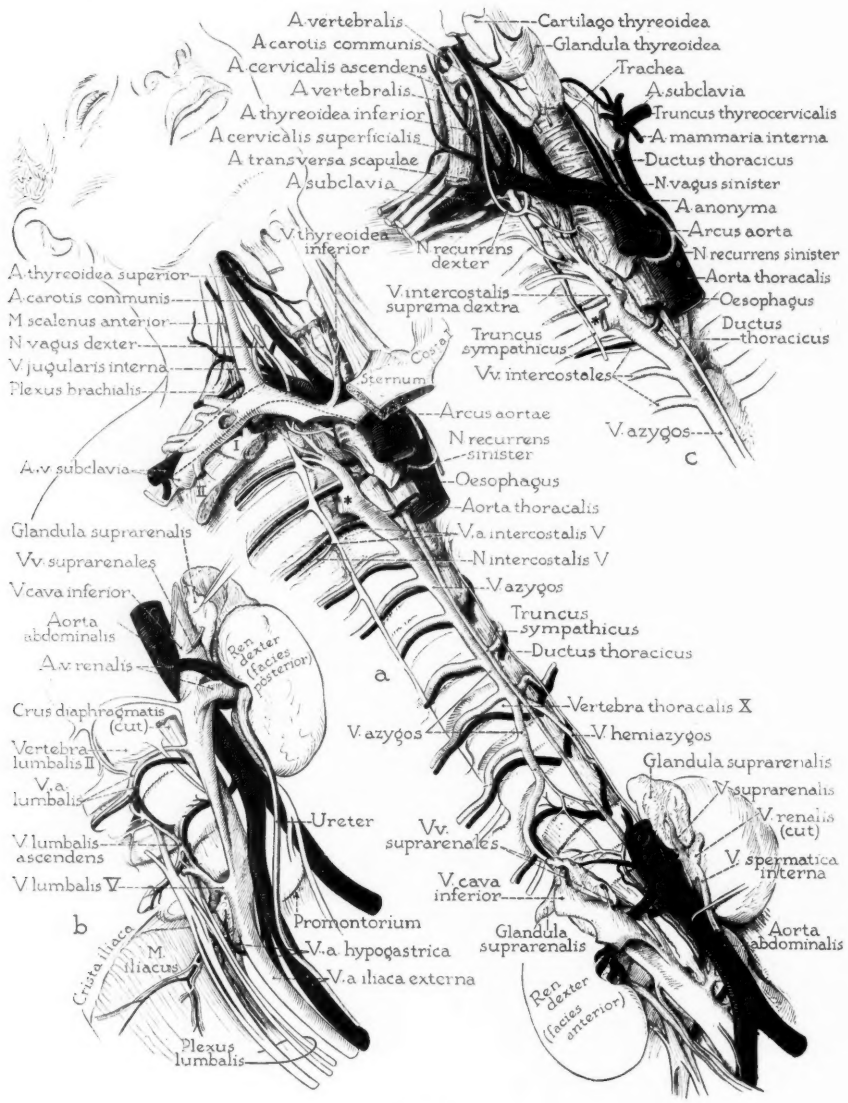

FIG. 4.

(Legend on facing page.)

second lumbar vein (Table V). There were 8 intermediate azygos roots whose level of caudal origin was the second lumbar vertebra; there were 6 roots which took their origin at first lumbar vertebral level, and 3 other roots which originated as far distally as the third lumbar. The termination of the intermediate azygos root usually occurred near the point at which the common trunk of the ascending lumbar and subcostal veins entered the azygos vein (Fig. 4a). The most cranial level at which the intermediate

FIG 3. (*Illustration facing page 1.*) Veins of the trunk and certain of their visceral tributaries, continued. Left side of specimen, in anterolateral view. a, On the left side a somewhat more complete exposure was afforded than in the corresponding figure on the right side, since the remnant of the sternum and the first rib were removed in preparation for deeper dissection of the neck on the right side (Fig. 4a). The following deep structures were shown: vagus nerve and its recurrent branch; cervical sympathetic chain; superior and inferior thyroid arteries; thoracic duct (at subclavian termination). In the thoracic division the intercostal and lumbar tributaries of the azygos vein were seen, together with related arteries and nerves and the ganglionated sympathetic chain. In the abdominal region the kidney and suprarenal gland were shown, as well as the ascending lumbar vein, through which, as an intermediary, they communicated with the left common iliac. b, The left kidney, with the suprarenal gland, has been rolled to the opposite side of the trunk on its vascular pedicle; the abdominal aorta has been retracted in order to expose the components of the prevertebral plexus of veins. The left common iliac artery has been excised in order to exhibit more fully the tributaries of the corresponding vein. c, The aortic arch has been retracted downward and to the right; aortic intercostals and related branches were thereby exposed. The stump of the left subclavian vein has been lifted, demonstrating termination therein of the thoracic duct. By this means, too, the cervicothoracic segment of the sympathetic chain was brought out to view. The inferior thyroid artery has been cut near the gland, the thyrocervical trunk and the related part of the subclavian artery have been removed from the dissection.

FIG. 4. Veins of the trunk, and certain of their visceral tributaries. Right side of specimen, in anterolateral view. a, On the right side the clavicle and a portion of the sternum have been removed in the cervical division of the dissection, the sternocleidomastoid and lower segments of the infrahyoid muscles have been excised, the dissection carried to the level (in depth) which permitted exposure of the trachea, thyroid gland, vascular contents of the carotid sheath, subclavian vessels, scalene muscles, and brachial plexus. In the thoracic division the dissection has been carried to the vertebral level, and revealed the contents of the posterior mediastinum (chiefly the veins of the azygos system, the sympathetic trunk, and the thoracic duct). In the superior mediastinum the following structures remained: aortic arch, trachea, esophagus, vagus nerves, and superior vena cava (only at the point of confluence of the innominate veins). In the abdominal region, similarly, the dissection has been carried to subserous level, with removal of portions of the digestive tube. The abdominal aorta, with its lumbar and renal branches, has been retained. The prevertebral tributaries of the lumbar and ascending lumbar veins were exposed, as was also the inferior vena cava (for which the parietal and visceral veins were tributaries). b, The right kidney and suprarenal gland have now been drawn to the opposite side of the body, in order to demonstrate the manner in which visceral and parietal tributaries reached the inferior vena cava, and the relationships between the segmentally arranged lumbar veins and the ascending lumbar veins. c, In order to demonstrate the interrelationship of deep structures at and near the superior aperture of the thoracic cavity, the following structures were removed: first and second ribs, with the costal segment of the anterior scalene muscle; the innominate veins and their tributaries (jugular, subclavian, and thyroid); the portions of the longus colli muscle which overlay the transverse processes of the sixth and seventh cervical vertebrae (in order to expose the vertebral artery and vein); the clavicle and piece of the sternum of the specimen's left side (which showed the termination of the thoracic duct in the subclavian vein).

azygos root made this union was that of the eleventh thoracic vertebra. The most frequent site was the ventral aspect of the body of the twelfth thoracic vertebra.

The intermediate hemiazygos root, on the other hand, coursed cranialward through the left crus of the diaphragm, to the left of the aorta, ventrolateral to the lumbar arteries, and dorsomedial to the lumbar sympathetic chain (Figs. 1a and b and 2a). After penetrating the diaphragm, the vessel coursed in the loose areolar tissue in the prevertebral area, to the left of the midline, and there became continuous with the hemiazygos vein. Just as in the case of the intermediate azygos root, the intermediate hemiazygos root regularly joined the hemiazygos vein over the ventral aspect of the twelfth thoracic vertebra, and never at a higher vertebral level than the eleventh thoracic. The intermediate hemiazygos root was present in 14 cases. It originated from the left renal vein in 5 cases (Fig. 1b), from the inferior vena cava in 4 instances, and from the segmental lumbar veins in the remaining 5 dissections (Table V). This root originated at the level of the second lumbar in 6 cases, and at first and third lumbar vertebral levels in 4 specimens each. In 7 cases the intermediate azygos and hemiazygos roots took origin from a common trunk, which in turn came from the inferior vena cava in 3 cases, and the segmental lumbar veins in 4 cases. The origin of this common trunk for the azygos and hemiazygos veins took place at the second lumbar level in 3 cases, and at the first and third lumbar levels in 2 specimens each (Table V).

The medial azygos and hemiazygos roots, instead of lying ventrolateral to the lumbar

TABLE Va.—SUMMARY OF THE NUMBER OF INTERMEDIATE AND MEDIAL ROOTS ENCOUNTERED, AND THE VERTEBRAL LEVEL OF ORIGIN

	Intermediate root			*Medial root*		
	Azygos	*Common*	*Hemi-azygos*	*Azygos*	*Common*	*Hemi-azygos*
L1.....	6	2	4	3	—	—
L2.....	8	3	6	5	2	1
L3.....	3	2	4	—	4	—

Data based on 50 specimens.
A common trunk formed by the intermediate hemiazygos root and the medial azygos root, which originated at the L2 level and terminated in the inferior vena cava, was encountered.
A common trunk formed by the intermediate azygos root and medial hemiazygos root, which originated at the L2 level and terminated in the inferior vena cava, was encountered.

TABLE Vb.—SUMMARY OF THE NUMBER OF INTERMEDIATE AND MEDIAL ROOTS ENCOUNTERED, AND THE VESSEL OF ORIGIN

Intermediate root			*Medial root*		
Azygos	*Common*	*Hemi-azygos*	*Azygos*	*Common*	*Hemi-azygos*
VC1-8	VC1-3	VC1-4	VC1-6	VC1-6	LL2-1
LL1-1	LL1-2	LRen.-5	RL2-1		
RL1-1	LL2-1	LL3-1	RL1 & LL1-1		
RL2-2	RL3-1	LL2-1			
LL2-1		RL3 & LL2-1			
Disc-4		Asc. L.-1			
		Disc-1			

Data based on 50 specimens.
Abbreviations: VC1, inferior vena cava; LRen., left renal vein; Asc. L., ascending lumbar vein; the letters before L1, L2, L3 refer to right or left side.

TABLE VIa.—GROUPING OF COMMON TRUNKS FORMED BY TWO LUMBAR SEGMENTAL VEINS, WHICH EMPTIED DIRECTLY INTO THE INFERIOR VENA CAVA

		Vertebral levels				
		1	*2*	*3*	*4*	*5*
Paired veins, same level		3	4	23	22	—
Same side, adjacent levels	L		—2—	—9—	—1—	
	R		—4—	—2—		
Opposite side, different levels	L			\ 5	\ 1	
	R			\	\	

TABLE VIb.—COMPILATION OF GROUPS OF THREE OR MORE LUMBAR SEGMENTAL VEINS WHICH FORMED COMMON TRUNKS, AND LUMBAR LEVEL AT WHICH THE COMMON TRUNK WAS FOUND

Vertebral levels				
1	*2*	*3*	*4*	*5*
—	1 (R2L2L3)	8 (L2L3R3)	2 (R4R4L4)	—
	1 (L1L2R2)	2 (L3R3R4)	1 (L4L4L4)	
		2 (L3L3R3)	1 (L3R4L4)	
		2 (R3R3L3)		
		2 (L1L2L3)		
		1 (L1R1R2)		
		1 (R1R3L3)		
		1 (R1R3L2L3)		
		1 (R2L2R3L3)		

arteries, as did the intermediate roots of origin, were dorsomedial to the lumbar arteries and dorsal to the aorta; usually they passed through the aortic hiatus of the diaphragm.

A single medial azygos root was present in 8 cases, and took its origin from the inferior vena cava 6 times, the right second lumbar segmental vein and a common trunk at the first lumbar level in a single instance each (Table V). The vertebral level of origin of the medial azygos root was at the second lumbar in 5 cases, and the first lumbar in 3 instances. A single medial hemiazygos root was found in only 1 specimen, and commenced at the second lumbar segmental vein on the left. In 6 dissections there was a common medial root; it originated from the inferior vena cava in all cases, at the third lumbar level in 4 instances, and at the second lumbar level in 2 cases. These common trunks subsequently divided into a medial azygos and hemiazygos root; the division of the common trunk generally occurred on the ventral aspect of either the first lumbar or twelfth thoracic vertebra. The medial roots continued in a cranial direction and laterally to join the azygos and hemiazygos veins. The location of this termination was usually similar to that of either the intermediate azygos or hemiazygos roots, and also the lateral roots. Consequently, these 3 roots of origin of the azygos and hemiazygos veins frequently converged on a common point, thereby forming a large portion of venous return for the thorax.

The following unusual variations in azygos and hemiazygos roots derived from a common trunk were found in 2 specimens: in one, by intermediate hemiazygos and medial azygos roots which originated in the inferior vena cava opposite the second lumbar vertebra; in the other, a common trunk was formed (at the same vertebral level) by an intermediate azygos root and a medial hemiazygos root of inferior caval origin.

The second component of the prevertebral system of veins consisted of a series of longitudinal vessels which coursed in the cephalocaudal axis on the ventral aspect of the vertebral column. These veins ran in the same direction as the medial and intermediate azygos and hemiazygos roots, but were not their direct continuations (Fig. 1b). The longitudinal veins were small, and served to connect segmental lumbar veins. In this series, veins of the type just described were found exclusively to the left of the midline (Table VII), and most often connected those at the third and fourth lumbar levels (24 such examples). There were 14 longitudinal veins between the second and third lumbar vertebrae, 7 veins between the fourth and fifth lumbar vertebrae and 6 such veins between first and second lumbar vertebrae. In no instance did a longitudinal vein connect a lumbar segmental vein with a vessel other than a lumbar vein of higher or lower level.

TABLE VII.—SUMMARY OF THE LONGITUDINAL CONNECTING VESSELS BETWEEN SEGMENTAL LUMBAR VEINS (EXCLUSIVE OF THE AZYGOS AND HEMIAZYGOS ROOTS OF ORIGIN)

	Vertebral levels			
	L 1–2	*L 2–3*	*L 3–4*	*L 4–5*
Left	6	14	24	7
Right	1	—	—	—

ASCENDING LUMBAR VEINS

The ascending lumbar veins were paired and lay dorsomedial to the psoas major muscle, adjacent to the vertebral bodies in the sulcus bounded by the centrum and the transverse process. The ascending lumbar vein then passed cranialward to join the subcostal vein, to become the lateral azygos and hemiazygos roots.

In the present authors' series the source vessel was the common iliac vein, with the exception of 8 instances in which the vessel of origin was either the inferior vena cava or the external iliac vein. The ascending lumbar was often variable in its course from pelvic origin to thoracic termination; it was either a single, large, uninterrupted structure in 149 cases (Fig. 1a and b), or a less prominent connection between segmental lumbar veins, lacking at one segment and present at another (Fig. 1c). There were 13 examples of interruption in the ascending lumbar vein, the majority of which occurred at the third lumbar level. One of the morphologic characteristics of the ascending lumbar vein was the manner in which it frequently divided into 2 or 3 channels that enclosed the ventral rami of the lumbar plexus as perineural venous rings (Fig. 1a and b). Lesser tributaries to the ascending lumbar veins were numerous; they came from such structures as the psoas muscle, the dorsolateral abdominal wall, the vertebral plexus, and rami of the segmental spinal nerves, as the latter emerged from the intervertebral foramina.

The ascending lumbar veins were dissected in 100 specimens at their origin and termination, but a complete exposure of the entire vessel was made in 81 cadavers. The origin of the ascending lumbar vein on the right was at the level of the fifth lumbar vertebra in 41 cases, and at the first sacral vertebra in 59 instances; on the left, this origin was opposite the fifth lumbar in 32 cases, and opposite the first sacral in 68 cases.

MISCELLANEOUS VEINS

A final group of vessels in lumborenal location was classed as a miscellaneous one, and included the following: 3 persistent left inferior venae cavae, 6 circumaortic venous rings, 2 retroaortic renal veins.

Because of obvious importance in urologic surgery, the specimens of left caval vein deserved individual description. In the first example (Fig. 5a), the left inferior vena cava took origin from the left common iliac vein over the intervertebral disc between the fifth lumbar and first sacral vertebrae; it coursed upward to the left of the midline and terminated at the inferior aspect of third lumbar vertebra in the left renal vein. This vessel received small rami from the left segmental lumbar veins at the fourth and fifth lumbar levels. The second and third segmental veins

formed a common trunk with the left inferior vena cava before these 3 vessels joined the left renal vein.

In the second specimen (Fig. 5b) the left inferior vena cava originated in the left common iliac vein at the level of the fifth lumbar vertebra, and then passed cranialward, to the left of the midline, in the prevertebral tissues as far as the superior margin of the third lumbar vertebra. During its course upward, the left fourth and fifth lumbar segmental veins emptied into the left vena cava. The third segmental lumbar vein on the left passed dorsal to the left inferior vena cava, to enter the right inferior cava; at the junction with the left renal vein, the left vena cava joined an intermediate hemiazygos root, which received the first and second segmental lumbar veins in its course cranialward.

The third example (Fig. 5c) represented a persistent left medial sympathetic vein (being dorsomedial in its relationship to the sympathetic chain). The left vena cava and internal spermatic vein formed a common trunk at the point of juncture with the left renal vein; a large intermediate hemiazygos root joined the left renal vein separately from the inferior vena cava on the left, the latter vessel receiving 2 small lumbar segmental veins at the third lumbar vertebral level, and sending a small trunk to the right vena cava at the third to fourth lumbar interspace.

DISCUSSION

Because of the complex scheme of development of the inferior vena cava, and the close embryologic association of the segmental lumbar veins with the caval vein, it was reasonable to expect that the adult pattern of the lumbar veins in any specimen might represent a departure from the anatomic norm. Actually, variations were common and the patterns numerous; they differed from the traditional descriptions, which have led to the belief that the lumbar veins were as regularly segmental as the intercostals.

Although Professor Seib's classical paper dealt chiefly with the azygos system of veins, rather than with those of the lumbar region, several examples of lumbar venous variation were presented (as found in 41 dissections). It was interesting to compare Seib's findings with those of the present series, in which the fourth lumbar veins occurred with complete regularity in all 100 dissections, while the fifth segmental vein was absent on the left 28 times, and on the right 37 times (Table I). In those instances in which the fifth segmental lumbar veins were absent, the origin of the ascending lumbar vein from the common iliac vein served as its substitute. Absence of segmental lumbar drainage did not affect the upper lumbar area, probably because of the various possible connections which were available with the subcardinal and supracardinal anastomoses, and the right inferior vena cava. The lumbar veins were single at a given level in most instances, although they were double on occasion (Table I).

Of a possible total of 1,000 lumbar veins, it was found that 539 veins terminated in the inferior vena cava; of this number, only 299 vessels remained separate, entering the vena cava directly. From the embryologic viewpoint, these observations indicated that if each connection of a transverse lumbar vein with the supracardinal or paraureteric vein persisted, the lumbar veins entered the adult vena cava individually (Fig. 6b, lower). Franklin pointed out that if the anastomosis between the vein of the medial sympathetic line and the supracardinal vein persisted, the adult lumbar vein would form a so-called common trunk with the inferior vena cava (Fig. 6b, middle). This arrangement was found on 240 occasions in this series of dissection. The common trunks occurred in the midlumbar region most frequently at the levels of the second, third, and fourth lumbar vertebrae (Table II). It was conceivable that the presence of the subcardinal anastomosis was responsible for these more complicated venous patterns. It should be noted that common trunks which terminated in the inferior vena cava were not found at the

level of the fifth lumbar vertebral interspace; the fifth segmental lumbar vein arose from the ascending lumbar and usually emptied into the common iliac vein.

Most standard anatomic accounts have failed to call attention to common lumbar trunks which terminate in the inferior vena cava. Common trunks of this type were most frequently formed by paired lumbar veins of opposite sides, at the same vertebral level (Table VI). Next in frequency of occurrence were common trunks formed by two lumbar veins of the same side but belonging to adjacent levels; there were only 6 examples of common trunks formed by two veins of the opposite side at different vertebral levels. When a common trunk was formed by two veins of the same side at consecutive vertebral levels, it was assumed that embryologically both intersegmental veins persisted, and that these two vessels were joined by a medial sympathetic vein, which in turn emptied into the right paraureteric or supracardinal vein. When two or more lumbar veins at different vertebral levels and opposite sides of the specimen joined to form a common trunk, in all probability both medial sympathetic veins and subcentral connections with the intersegmental lumbar veins persisted. The various combinations of vessels which have remained, or were partially obliterated, may be traced in Figure 6c and d.

The ostia of the common trunks occurred consistently at the same or lower vertebral levels than the component veins, and were found on the dorsal aspect of the inferior vena cava, in the prevertebral connective tissue. The common trunks were not more frequent on one side of the body than the other.

In those cases in which segmental lumbar veins neither entered the inferior vena cava directly nor did so by way of a common trunk, they terminated in nonvascular structures or venous channels other than the vena cava. In the present series, 45 per cent of the veins terminated in either of these two atypical ways. In a surprisingly large number of instances the first lumbar vein entered the intermediate or medial azygos or hemiazygos roots (Table IV). Such union between the azygos and hemiazygos roots and the first segmental lumbar vein probably represented an embryonic anastomosis between the first intersegmental lumbar vein and the medial sympathetic or subcostal veins. It was a fairly common type of variation, and was found in 85 per cent of those cases in which

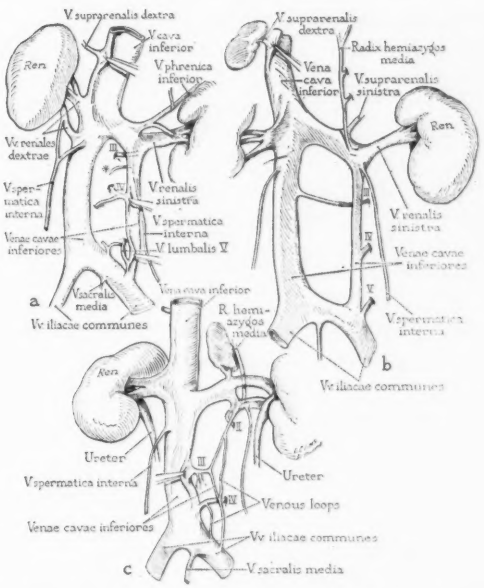

FIG. 5. Three examples of persistent left caval vein were encountered in the course of 100 dissections of the present authors' series. Arranged in the order of decreasing caliber of the persistent, "anomalous" vessel. In each instance the caval vein connected the iliac with the renal. a, The large left inferior vena cava communicated with the fifth, fourth, and third lumbar veins in its course to the renal, and also received the internal spermatic vein. b, The most caudally situated vein (fifth) of the lumbar series terminated in the left iliac near the point of origin of the caval vein; the third crossed to the "normal" inferior vena cava of the right side. The internal spermatic vein ended in the renal extremity of the left caval vein, the latter then being continued cranialward as the intermediate hemiazygos root. c, The small left inferior vena cava communicated with a regular caval vein of the right side through a third lumbar vein; as a paravertebral channel (represented in the thorax by the hemiazygos root), it was interrupted by connection with the caudal limb of a bifid renal vein. This point of renal connection was one of convergence of the lumbar, suprarenal, and thoracic (hemiazygos) vessels.

the first segmental lumbar vein terminated in other vessels or structures (with insignificant incidence at the other interspaces).

A further finding in the adult, which invited embryologic speculation, was the occurrence of a continuous transverse channel formed by right and left lumbar veins, with no other vascular connections. This adult pattern occurred at the first and third lumbar vertebral levels in 1 case each, and represented a completely intact intersegmental embryonic lumbar vein without other vascular anastomoses; in respect to this pattern, Seib made the following comment, "In one case, the five right lumbar veins drained into the right ascending lumbar, and the five left lumbars into the left ascending lumbar vein; thus, not a single lumbar vein could be observed draining into the inferior vena cava." Presumably these veins, all connected across the midline, represented five intact intersegmental veins in the form in which they existed in the embryo (compare schema in Fig. 6b, top).

The discrepancy between the sites of termination of the second lumbar vein, on right and left sides, was an unusual feature (Table II). Actually, the right second lumbar vein entered the vena cava approximately 6 times as often as its partner on the left, which terminated in the left renal vein (30 occasions) or an azygos root (in 11 specimens) (Table IV). It is probable that union with the left renal vein was due, developmentally, to a medial sympathetic or subcentral-intersubcardinal anastomosis (Fig. 6d, top); when the segmental vein drained into the azygos or hemiazygos roots, a direct anastomotic communication existed between the lumbar vein and the subcentral or medial sympathetic vein (Fig. 6c, top). The existence of the anastomosis, which represented the definitive left renal vein, probably accounted for the fact that the latter vessel so often received the second left lumbar vein (Fig. 6d).

The lumbar veins at the first lumbar interspace emptied into nonvascular structures more frequently than at any other vertebral level. They were invariably of small size when they terminated in bone, connective tissue, or intervertebral fibrocartilage; they often made their terminations in structures distal to the first lumbar level. The vertebral level of termination of lumbar veins which entered the inferior vena cava directly was the same as the origin of the vein in 80 per cent of the cases. A lumbar vein passed to a superior level to find its drainage on only 2 occasions in the 100 dissections; these occurred at the fourth and fifth lumbar levels (Table III).

Hovelacque described the origin of the azygos and hemiazygos veins as arising in the thoracic cavity from one or two roots. The so-called external root was pictured as large, regular, and formed by the junction of the ascending lumbar vein and the subcostal; a smaller and more irregular internal root took origin from the dorsal aspect of the inferior vena cava, when present. Mutel and Fourche offered a similar description for the azygos and hemiazygos roots, but suggested the terms medial and lateral. Gladstone suggested the term "lumbar-azygos veins," which included the medial and intermediate roots of origin of the azygos and hemiazygos veins, described by Seib; the latter author further stated that the term lumbar-azygos vein should be reserved for a vein that corresponded to the intermediate azygos root of his terminology.

Dissection experience revealed that the lateral azygos roots were present in 50 dissections, and in 2 specimens, the lateral hemiazygos root was absent. Seib found a bilateral incidence of the lateral roots in 85 per cent of 190 specimens. Although the cranial portion of the ascending lumbar vein was never absent in the present series of dissections, Seib described 2 such examples. In a single specimen of the present series, the subcostal vein was absent, and the lateral azygos root was considered an upward prolongation of the ascending lumbar vein. The literature contained no reference to the fact that the ascending lumbar vein could be prolonged into the thoracic cavity, there to make termination in an intercostal vein of higher

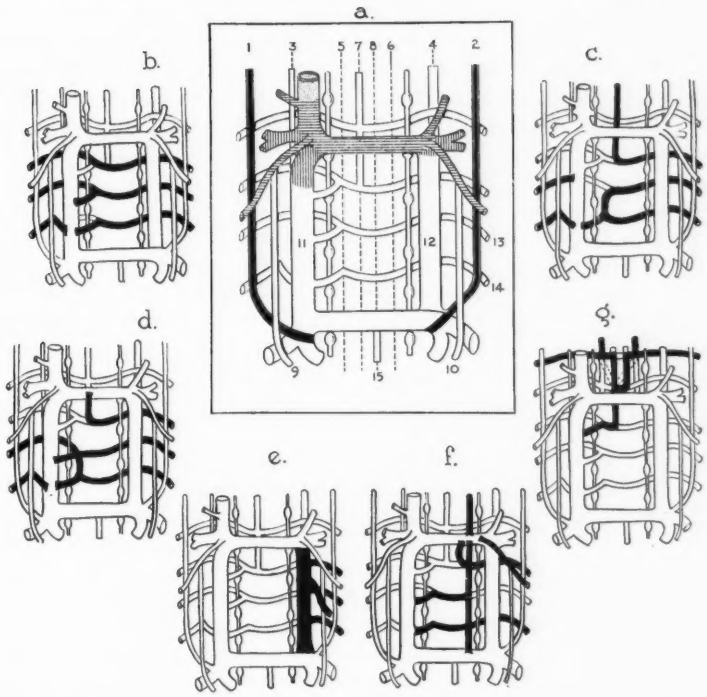

FIG. 6. Origin of various patterns in the lumbar and related venous communications. a, A composite of the embryologic venous system from which complex and definitive adult venous patterns were derived. The origin of the inferior vena cava and segmental lumbar veins is shown in a schematic way. Key: stippled areas, hepatic portion of inferior vena cava; horizontal hatching, subcardinal; vertical hatching, subcardinal-paraureteric anastomoses; black areas, posterior cardinals; *1*, *2*, posterior cardinal veins; *3*, *4*, veins of thoracolumbar lines; *5*, *6*, veins of medial sympathetic lines; *7*, right medial azygos root; *8*, left subcentral line; *9*, *10*, subcardinal veins; *11*, right paraureteric vein; *12*, left paraureteric vein; *13*, left third lumbar segmental vein; *14*, left fourth lumbar segmental vein; *15*, middle sacral vein. (After Franklin, K. J. *A Monograph on Veins*. Springfield: Charles C Thomas, 1937.) b, Top black area, The unusual occurrence of a continuous transverse channel formed by a right and left lumbar vein with no other venous communication. Middle, The anastomosis between the vein of the medial sympathetic line and the supracardinal vein has persisted, so that the adult lumbar vein entered the inferior vena cava by a so-called common trunk. Lower, Each connection of the transverse lumbar vein has persisted, so that the adult lumbar vein entered the vena cava individually. c, Top black area, The segmental lumbar vein has joined a subcentral vein, or the adult medial azygos root. Middle, Lumbar veins of different vertebral levels, but the same side of the body, have joined through a medial sympathetic vein. d, Top black area, A lumbar vein has joined the left renal vein through a medial sympathetic vein. Middle, Two lumbar veins of different vertebral levels and opposite body sides have formed a common trunk, probably through a persistent medial sympathetic vein at one level and a medial sympathetic-paraureteric anastomosis at another level. e, This persistent left inferior vena cava was derived from the left paraureteric (supracardinal) vein based on the large caliber of the vessel, the manner of termination of the internal spermatic vein, and the absence of an intermediate hemiazygos root. f, Another left inferior vena cava was of particular interest because it lay dorsomedial to the sympathetic chain, ventrolateral to the lumbar arteries; in addition, the internal spermatic vein and left vena cava formed a common trunk at the point of union with the renal vein on the left; the intermediate hemiazygos root entered the dorsal aspect of the left renal vein. These facts established this left vena cava as a derivative of the medial sympathetic vein. g, The embryonic veins which probably established the Y-shaped common medial trunks of the adult azygos and hemiazygos veins. This served as a striking example of some of the complex mechanisms involved. In the formation of the Y-shaped common medial azygos and hemiazygos trunk, the following embryonic veins or segments of veins have persisted: subcentral-medial sympathetic anastomosis at twelfth thoracic level; right and left sub-central veins between thoracic and lumbar levels; intersubcentral anastomosis at first lumbar level; right subcentral vein in lower lumbar region; right subcentral-medial sympathetic anastomosis at lower lumbar level; right medial sympathetic-paraureteric anastomosis in the lumbar region.

level than the twelfth thoracic. In Professor Seib's series, the right ascending lumbar drained into the eleventh intercostal in 10 of 41 specimens, the left ascending lumbar in the eleventh intercostal in 9 instances, and in the tenth in a single case. In 4 of these cases, each ascending lumbar emptied into the eleventh intercostal vein. These observations stood in sharp contrast to the 2 instances in the present series of dissections, in which the ascending lumbar vein extended cranialward to join the eleventh intercostal vein (in 1 specimen bilaterally).

As previously stated, the intermediate azygos roots were ventrolateral to the lumbar arteries and dorsomedial to the sympathetic trunks; in this set of dissections, approximately 17 such veins were found. There were 8 intermediate azygos roots that originated from the inferior vena cava, 4 over an intervertebral disc, and the remainder from the first or second lumbar veins. This represented an incidence of 34 per cent as compared to the 45 per cent recorded by Seib. Hovelacque noted an incidence of 60 per cent of intermediate azygos roots; in several cases the root continued cranialward, to terminate in the eighth or ninth intercostal veins. Of the 17 intermediate azygos roots found in the present series, the most cranial termination was at the eleventh thoracic level. The intermediate hemiazygos root also passed ventrolateral to the lumbar arteries, dorsomedial to the lumbar sympathetic chain, but through the left crus of the diaphragm, and to the left of the aorta. The intermediate hemiazygos root was present in 14 cases (or 28 per cent) of the specimens in the present series, which duplicated the incidence recorded by Seib (as found in 200 specimens).

The highest incidence of intermediate hemiazygos roots was reported by Andreassi in a series of 50 dissections. Of the 14 intermediate hemiazygos roots present, 5 originated from the left renal vein, a figure of considerably less magnitude than reported by Lejars, who described this origin from the left renal vein in 88 per cent of the cases in which an intermediate hemiazygos root was present. Seib failed to mention that the intermediate hemiazygos root occasionally took origin from the segmental lumbar veins. It was found to originate opposite the second lumbar vertebral level most often, and opposite the first and third lumbar levels on 4 occasions each, so that its course cranialward was usually a long one, and the caliber of the vein was generally substantial. Seib stated that the intermediate azygos and hemiazygos roots occurred simultaneously in approximately 23 per cent of all specimens; he also described a common root of origin for the medial azygos and hemiazygos veins. However, a common root of origin was not mentioned for the intermediate roots; in the present series there were 7 examples of a common root from which the intermediate azygos and hemiazygos veins originated. The common root for these particular veins possessed the same relationship to the sympathetic chain and lumbar arteries as did the separate roots. The common trunk represented portions of the medial sympathetic-subcentral veins which have persisted. It originated from the vena cava in 3 cases, and the segmental lumbar veins in 4 cases.

The medial azygos and hemiazygos roots were derived from the "subcentral vein," a term suggested by Reagan; the incidence of a medial root of origin, as reported by Seib, was 46 per cent in 200 cadavers; in the present authors' series there were only 15 examples in a total of 50 dissections. Of this group of 15 cases, there were 8 medial azygos roots which occurred alone; 6 veins arose from a common medial root; a single medial hemiazygos root was found. As established by Seib, these medial roots received upper segmental lumbar veins as tributaries, and in the present series, most frequently at the first lumbar level (Table IV). It should be noted that 80 per cent of the medial roots reported herein took origin from the inferior vena cava, and arose from its dorsal aspect; the remainder were traced to the segmental lumbar veins (L1 and L2). After arising in this fashion, the medial azygos and hemiazygos veins continued in a cranial

course, dorsomedial to the lumbar arteries; passing through the aortic hiatus of the diaphragm, they joined their respective veins.

The common medial root of the azygos and hemiazygos has been referred to, and each of the 6 examples found in this series arose from the vena cava at the second or third lumbar vertebral levels. This vessel was called simply the "common medial root" by Seib. Each of its two branches coursed in a cephalic direction, obliquely and lateralward, to become continuous with the distal portions of the azygos and hemiazygos veins; in so doing, they assumed a Y-shaped vascular configuration. Embryologically, this common medial root was a persistent twelfth intercostal vein, continuous with both the medial sympathetic and subcentral veins which were prolonged from this vertebral level distalward. The primary result was a T-shaped vessel; secondarily, during subsequent growth and changes in blood flow, the vessel assumed a Y-shape, being stretched in a caudal direction (Fig. 6g). In the present series, there were 2 examples of a common trunk. In one, the arms were formed by an intermediate hemiazygos root and a medial azygos root; in the other specimen, there was a common connection with intermediate azygos and medial hemiazygos roots.

The second major component of the prevertebral system was a series of 52 veins, which coursed longitudinally along the ventral aspect of the vertebral column. These longitudinal veins were consistently small in caliber (Fig. 1b), and were found only to the left of the midline. This latter fact could possibly be explained by the anatomic location of the right paraureteric vein, the presence of which physically allowed no space for these small channels. These longitudinal veins, which served to join adjacent lumbar veins, were not continuous with the azygos or the hemiazygos roots. They probably represented either a persistent lateral connection between the left paraureteric vein and lumbar vein, or a connection between a left paraureteric vessel and a medial sympathetic anastomosis. There were no observations in the earlier literature on these longitudinal veins, although Seib described similar connections in the thoracic region.

The ascending lumbar veins were derived from the embryonic veins of the lumbocostal lines (Fig. 6a). It was found that of 162 dissected (81 cadavers) ascending lumbar veins, 149 were large, uninterrupted channels which connected the segmental lumbar veins, as well as the iliac and subcostal systems. Seib described several specimens in which the cranial aspect of the ascending lumbar vein was lacking; however, this variation was not encountered in the present series of dissections. The interruptions in the course of the ascending lumbar vein were recorded in this group of dissections (Fig. 1c). The highest thoracic level which any ascending lumbar vein reached was the eleventh, although other authors have reported that the ascending lumbar may empty into the ninth costal vein. The fifth lumbar vein was most often absent in this set of dissections, but its drainage was taken over by the origin of the ascending lumbar vein in the region of the lowermost vertebral body (Table I). The caudal origin of the ascending lumbar vein was always present. As recently as 1929, Gladstone stressed the need for more accurate descriptions of the ascending lumbar vein, which, for example, had been described inadequately by Testut.

Lastly, as components of the inferior caval venous system, the several examples of persistent left inferior vena cava, and of circumaortic venous ring, required discussion. The incidence of the left inferior vena cava has been reported in the literature as follows: Augier, 0.2 to 3.0 per cent; Zumstein, 2.7 per cent; Gladstone, 0.23 per cent (in a series of 876 cadavers); and Seib, in 5 of 176 specimens (2.8 per cent). Seib stated that the over-all incidence of bilateral venae cavae probably would be 3 per cent, and that of the persistent left inferior vena cava occurring alone, approximately 0.5 per cent.

The occurrence of 3 examples of left inferior vena cava in this series of 100 cadavers

represented an inordinately high rate of incidence; there was no specimen in which a persistent left inferior vena cava occurred alone.

In the specimen with the largest left caval vein, the vessel received several lumbar veins in its upward course, as well as the internal spermatic vein; an intermediate hemiazygos root was wanting (Fig. 5a). The large caliber of the left vena cava, the mode of termination of the internal spermatic vein, and absence of an intermediate hemiazygos root pointed to the left paraureteric (supracardinal) vein as the embryonic vessel from which this left vena cava was derived (Fig. 6e).

In the second example of a persistent left vena cava (Fig. 5b), the internal spermatic vein ended in the left renal vein, to the left of the vena cava of that side; an intermediate azygos drained into the left renal vein. It was probable that this left inferior vena cava was a derivative of a medial sympathetic vein.

The third example of persistent inferior vena cava (Fig. 5c) was of great interest because the following relationships identified it as an embryonic product of a medial sympathetic vein (Fig. 6f): the vein lay dorsomedial to the sympathetic chain, ventrolateral to the lumbar arteries; the internal spermatic vein and left vena cava formed a common trunk at the point of union with the renal vein on the left; the intermediate hemiazygos root entered the dorsal aspect of the left renal vein.

There were 6 examples of circumaortic venous ring[4] in this series of 100 dissections, all of which were associated with normal left preaortic renal veins. Seib has pointed out that the retroaortic renocaval arch was embryologically derived from the left medial sympathetic-subcardinal anastomosis and the lumbar medial sympathetic vein (Fig. 6a). It was found that in 2 of the 6 specimens an intermediate hemiazygos root emptied into the left renal vein. The retroaortic renocaval arch, or limb, was smaller than the renal vein; there were 2 retroaortic renal veins, which emptied into the right vena cava at a more caudal level than the right renal vein.

[4]Gerard referred to the circumaortic venous ring as the "anastomose veineuse renocave retro-aortique"; the term "reno-azygo-lumbar arch" was also used. Huntington and McClure employed the terminology "circumaortic venous ring," which emphasized the relation of the venous ring to the aorta. The term "retroaortic renal vein" would also seem to be logically applied, because it was the dorsal segment of the arch which cared for renal venous drainage when the normal preaortic renal vein was absent.

SUMMARY

Most standard references and text sources have considered the lumbar veins as a series of 3 or 4 simple segmental channels, which connect the ascending lumbar vein and inferior vena cava in a direct, uncomplicated manner.

However, in a study of 100 adult cadavers, it was found that instead of the pattern generally described, these veins were complex in their arrangement.

The lumbar system of veins was divided into: segmental lumbar veins; the prevertebral system, which included azygos, hemiazygos roots, and longitudinal veins; the ascending lumbar veins; and a group of persistent embryonic veins not generally encountered in the lumborenal area.

The lumbar segmental veins were regular in their occurrence at all vertebral levels except the fifth lumbar; they generally terminated in the inferior vena cava, except at the first and fifth lumbar levels, where they usually drained into structures or vessels other than the inferior vena cava. These were: the azygos or hemiazygos roots, the common iliac veins, and the renal veins. The segmental lumbar veins generally terminated in the inferior vena cava at the vertebral level from which they took origin.

The prevertebral system included the roots of origin of the azygos and hemiazygos veins, and the longitudinal connecting veins; the last-named joined adjacent segmental lumbar veins and occurred almost exclusively on the left side of the body.

The ascending lumbar veins were, with few exceptions, continuous longitudinal channels which provided a collateral route

of circulation between the great veins of the pelvis and the parietal system of the thorax. The lumbar segmental veins regularly communicated with the ascending lumbars.

In the present series of 100 dissections there were 3 examples of persistent left vena cava, 6 of circumaortic venous ring, and 2 of retroaortic renal vein. The possible embryonic origin of these structures was discussed.

Batson drew attention to the anatomy of the vertebral (or meningorachidian) system of veins, and their role in the spread of metastases from the pelvis; to these routes must be added the larger and direct venous channels of the lumbar system of veins. Various other anatomic and surgical studies (viz., that of Robinson) have shown the importance of the lumbar system of veins as collateral venous channels, following ligation of the inferior vena cava. More recently, Surington and Jonas, Tori, and Abrams have demonstrated these routes by venography. This venous system most probably is the offending agent in many cases of retroperitoneal bleeding which follows trauma to the back and the abdomen. In surgical procedures about the renal area, large anomalous veins in the form of hemiazygos roots, an occasional persistent left inferior vena cava, or circumaortic venous ring have obvious importance. Removal of the sympathetic chain in the lumbar region, for various therapeutic reasons, should be facilitated by a knowledge of this complex system of venous drainage—whose tributaries are so closely related to the ventral and lateral aspects of the vertebral bodies.

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CLINICAL PATTERNS OF PEPTIC ULCER AFTER SIXTY

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WHILE it has been generally recognized that peptic ulcer develops most frequently in patients in the active middle years of life, a very considerable number of patients seek relief from the distress of gastric and duodenal ulcers and their complications after the age of 60 years. This fact was exemplified in a review of 3,049 cases of peptic ulcer recorded at the Roosevelt Hospital during the 16 years from 1940 through 1955. Four hundred thirty patients over 60 years of age were hospitalized for this condition.

The average age of these patients was 66.4 years. The oldest was 89 years old. There were 319 men and 111 women. The distribution of ulcer location in these patients (Fig. 1) was duodenal, 286; gastric, 126; both duodenal and gastric, 8; marginal, 10. Since cancer is likely to be suspected in patients of this age who present gastric symptoms, especially if accompanied by x-ray findings of an ulcerative lesion, it was of interest to note that during this same 15 year period there were admitted 176 patients over 60 years old with cancer of the stomach. The incidence of malignant neoplasm, then, was 41 per cent higher than that of gastric ulcer.

The site of the gastric ulcers was recorded as being on the lesser curvature in 121 cases and on the greater curvature in 5. In 8 cases the gastric ulcerations were multiple. Of the duodenal ulcers demonstrated at operation or by autopsy, 34 were deep, penetrating the intestinal wall, and in 6 instances they invaded other organs (pancreas, 4; liver, 1; gallbladder, 1). Twenty-three were described as of stenosing type. In 8 cases there were combined gastric and duodenal ulcerations, while multiple duodenal ulcers were found in 3 instances.

The clinical status of these patients was of interest as having some bearing on the progress of the ulcer condition and of definite significance relative to the treatment and its results. There was a high incidence of arteriosclerosis in these patients as noted at autopsy by Schanke. He considered atheromatous changes as a likely etiologic factor, having found them in every ulcer patient over 60 years old. In the present study arteriosclerosis was specifically recorded in 186 cases (43 per cent). This and the following diseased conditions were noted in our records, occurring either singly or in combination: 158 patients were sufferers from clinically manifested cardiovascular disease (arteriosclerotic or hypertensive heart disease, or coronary occlusion); 33 from prostatism; 26 had or had had cholecystitis; 25 were anemic; 23 were afflicted with chronic bronchitis and emphysema; 23 were victims of cancer (cervix, bladder, breast, prostate); 14 had kidney lesions; 14 were notably obese; 12 had cirrhosis; 10 had arthritis; 9 diabetes; and 9 Parkinson's disease. In the rarer categories were 7 with tertiary syphilis, 5 with tuberculosis, while 6 suffered from fibroids, 4 from malnutrition, and 3 each from aortic aneurysm and goiter. There were 6 hemiplegic patients. The habits of these patients were not carefully recorded. Excessive use of tobacco was noted in 56 instances and of alcohol in 17.

The histories of these elderly sufferers from ulcers presented a degree of uniformity of symptoms (Fig. 2). Pain, persistent or recurrent in episodes, was a complaint common to almost all of them. In addition to the pain there had been vomiting in 220, melena in 176, weight loss in 138, hematemesis in 107, constipation in 82, "gas" in 76, "fullness" in 32, and eructations in 29. Many had various combinations of these complaints. When no pain

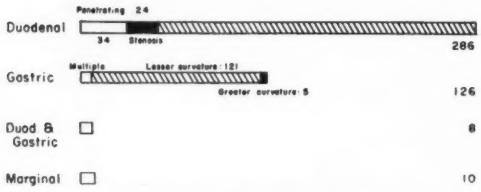

FIG. 1. Distribution and pathology.

was manifest vomiting occurred in 20 instances (hematemesis in 15), melena in 24. Relief from ingestion of alkaline medication was reported by 55 patients, from the taking of certain types of food by 33, while 101 were relieved by either.

The duration of symptoms was strikingly in contrast to that observed in the younger age groups. Of the 430 patients, 321 had suffered for more than 6 months, the longest for 63 years. The duration in 13 was not recorded. Sixty-two of the histories dated back 20 years or more, while the average duration of symptoms was 11 years. One hundred nine were recorded as having symptoms for less than 6 months. Of the 109 patients whose symptoms were of 6 months' duration or less, there were 32 instances in which a recent or current illness might have been an etiologic factor. Among these were 7 cases of carcinoma, 7 of recent episodes of heart disease, 3 of cirrhosis, 3 of anemia; 8 patients had undergone recent major surgery, 2 were diabetic, 1 a recent hemiplegic, and 1 had suffered distress from an abdominal aortic aneurysm. In 77 there was no ostensible precipitating cause. Hemorrhage and perforation accounted for nearly all of the hospitalizations in this short-term group.

Analysis of the histories, symptoms, and findings in these older patients indicated certain patterns:

1. The largest number by far had suffered from ulcer symptoms for many years. These sought hospitalization eventually for the following reasons: (1) hemorrhage occurring after years of pain and occasionally after long-separated episodes of hematemesis or melena; (2) perforation, occurring usually after the persistence of symptoms for many years; (3) persistent and severe vomiting, from pyloric obstruction, after years of pain and perhaps other symptoms, notably attacks of vomiting, gas, constipation, loss of weight, and perhaps occasional melena; (4) least commonly persisting pain with occasional vomiting, loss of weight, constipation, eructations, weakness, or anorexia not controlled by diet or medication.

2. A much smaller group consisted of patients seeking aid because of the acute symptoms of fresh ulceration, particularly: (1) hemorrhage occurring without premonitory pain or with pain of short duration; (2) perforation with little or no preceding pain or with a short history of ulcer symptoms.

The stories of these patients served, for the most part, as a fairly clear index of the diagnosis, although on this basis alone it was impossible to differentiate accurately between the peptic ulcers of the stomach and those of the duodenum. Certain of the histories of complaints of medium and short duration also were strongly suggestive of cancer although, as Brush has pointed out, long duration of ulcer is no assurance of benignity, while Smith and Jordan maintain that 20 per cent of stomach cancers have their origin in ulcers.

Of the diagnostic aids in establishing a correct estimate roentgenography was by all odds the most helpful. In presenting the diagnosis of duodenal ulcer this medium was correct 229 times and wrong 6—2 of the errors being made in the presence of active bleeding. The diagnosis of stomach ulcers was correct in 93 instances and wrong in 11. Each of the 11 errors consisted in mistaking ulcer for cancer. In 32 perforations of the duodenum, free air was shown in 22 and absent in 10. In 12 stomach perforations, the readings were positive 5 times and negative 7. One interesting finding of uncertain significance was the discovery of 32 hiatus hernias in 382 positive x-ray examinations for ulcer (8.4 per cent).

Measurements of the gastric acidity were of questionable value in diagnosis. It is per-

haps for this reason that relatively few such tests were recorded, particularly between the years 1951 and 1954. Only 87 estimations in all were made with average readings of 76 for free acid and 93 for combined. Of 14 cases of gastric retention of 25 per cent or over, 8 showed total acid under 50, while 6 registered 50 or more. On the other hand, 9 patients without obstruction but with typical active ulcer syndrome had combined acid readings of less than 50. Brush has observed that cancer of the stomach is often seen with hyperacidity, while Stafford has noted that acidity does not decrease with age but often increases and that it is not uniformly decreased in pyloric stenosis.

Gastroscopy was not frequently employed after an initial trial period between 1944 and 1948. The diagnostic record of 23 examinations was: 9 correctly reported positive for ulcer, 13 incorrectly reported negative for ulcer, 1 incorrectly reported carcinoma in a case of benign gastric ulcer. Smith and Jordan reported that gastroscopy was 73.1 per cent accurate in discriminating between benign and malignant gastric lesions when the lesion could be seen, but that in 25 per cent of cases examined the ulcer could not be visualized. Brush and Priest reported that 50 per cent of roentgenographically visualized ulcers could not be seen by gastroscopy; also that in attempted differentiation in their series, 7 ulcers reported malignant were all benign, and of 10 reported benign, 1 was malignant.

Pursuing further the study of manifestations of peptic ulcer found in these older patients, the symptoms were grouped under the major headings of bleeding, perforation, obstruction, and intractability. Since 1 patient might show 1, 2, or even more of these complications, they were listed by incidence rather than by patient. Thus, in ulcerations of the stomach, 130 manifestations were encountered as follows: bleeding, 47 times; perforations, 10; obstruction, 15; and intractability, 58. In ulcers of the duodenum the record (Fig. 3) showed bleeding 107 times, 37 perforations, 41 obstructions, and

FIG. 2. Incidence of symptoms (often multiple).

127 manifestations of intractability. In marginal ulcers there was 1 case of bleeding and 3 of obstruction.

Bleeding was the most frequent major complication occurring in these patients. The cases of hemorrhage showed two patterns: (1) chronic or occasional bleeding, 100 cases (duodenal, 84; stomach, 16). In conjunction with other ulcer symptoms, these patients had in years past suffered single attacks or recurring episodes of hematemesis or melena; of these there were two categories: (a) those whose present admission was for a repetition of moderate bleeding or for incidental complaints (73); (b) those who had developed acute and severe bleeding (27—duodenal, 23; gastric, 4). (2) Acute, severe bleeding occurring following a short history of ulcer symptoms or with no premonitory discomfort (87—duodenal, 60; stomach, 27). This type was particularly noted by Butler.

In one small group of patients, 6 in number, bleeding developed as a precursor of perforation. These represented 14 per cent of perforations as compared with Kahn's figure of 10 per cent. Sixteen of the bleeding patients had had previous opera-

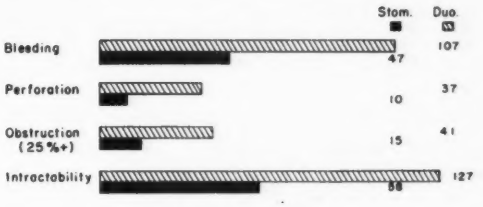

FIG. 3. Complications.

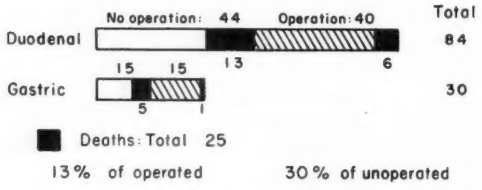

FIG. 4. Active hemorrhage.

tions as follows: closure of perforation, 6; gastroenterostomy, 8; Billroth I and II, 1 each.

Regarding the cases of chronic and occasional bleeding, medical treatment alone was employed in 34 patients with duodenal ulcers resulting in 2 deaths and in 7 with gastric ulcers resulting in 3 deaths. Subtotal gastrectomy was performed in 42 patients with chronic duodenal ulcer bleeding with 8 deaths; and gastroenterostomy alone was done in 4 cases, gastroenterostomy with vagotomy in 2, and vagotomy alone in 2—all without fatality. There was 1 antral exclusion for bleeding stomach ulcer.

Of the 27 patients with acute severe hemorrhage in whom bleeding had previously occurred, medical treatment was given to 9 with duodenal ulcers resulting in 4 deaths and to 1 with gastric ulcer which was fatal. Gastrectomy was performed 13 times for duodenal lesions resulting in 5 deaths and for gastric ulcer 3 times with 1 death. Gastroenterostomy was employed in 1 patient with duodenal ulcer who survived.

Of the 87 cases of acute severe bleeding occurring *de novo*, 35 of duodenal and 14 of gastric origin were treated by medical therapy alone. Eight of the former and 4 of the latter resulted in death. Subtotal gastrectomy was performed upon 23 patients with bleeding duodenal ulcers with 1 death and on 12 with gastric lesions with no fatalities. Vagotomy was performed for

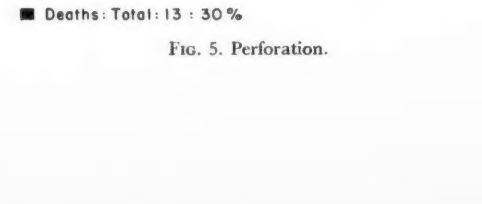

FIG. 5. Perforation.

bleeding duodenal ulcers in 2 cases and pyloric exclusion in 1 with no deaths.

The over-all mortality for acute hemorrhage was 21 per cent. Of those treated surgically it was 13 per cent. This figure compares favorably with Swynnerton's figure of 80 per cent good results and Stafford's of 23 per cent mortality. Recurrence of bleeding was noted in 1 case in which subtotal gastrectomy was performed for bleeding duodenal ulcer.

It might be noted, in extenuation of the employment of nonsurgical treatment in so many cases, that a number of the patients could not be brought out of shock sufficiently to permit operation, while some others refused surgery. The unoperated upon survivors were those in whom bleeding was less profuse or came readily under control and did not recur. The use of several lesser operations in this group might be justified on the basis of Heuer's dictum: "The primary object of surgery is to control hemorrhage and save life, the treatment of the ulcer from an immediate viewpoint is secondary, as it is in perforation." Gordon-Taylor has also said: "The treatment of ulcer hemorrhage is not synonymous with partial gastrectomy." He confessed to having done a variety of lesser operations with success in the presence of hemorrhage, and having employed surgery in only one-third of the cases of hematemesis in his experience. The procedure of simple gastrotomy with local hemostatic suture of the ulcer as recommended by Albright and Kerr was not adopted in any recorded instance.

The second most frequent emergency complication of peptic ulcer responsible for the hospitalization of patients over 60 years old was perforation. Forty-three of these were recorded, 8 being of the stomach, 35 of the duodenum. As in hemorrhage there were two groups of patients: those whose symptoms were of long duration, often several years, and those whose perforations occurred after symptoms of less than a month's duration or came on suddenly without premonitory symptoms. There were

22 perforations in patients whose symptoms had existed more than a month (17 of the duodenum, 5 of the stomach). Ten patients had symptoms for less than a month (9 duodenal, 1 stomach), while 11 others (9 duodenal, 2 gastric) had no history of stomach ailment prior to a sudden perforation. Of the patients with symptoms of long duration, in 2 perforation had occurred before (in 1 of them twice—a man of 81, who died from the third perforation).

The symptoms and signs attending these perforations in elderly patients often differed materially from the classical picture as pointed out by Schanke and by Stafford. The dramatic onset of severe pain with boardlike abdominal rigidity frequently did not occur, the onset tending to be more insidious with diffuse abdominal pain. There was difficulty in differentiating some of these cases clinically from coronary occlusion, cholecystitis, or pancreatitis. Air beneath the diaphragm was demonstrated by x-ray examination in 22 of the 43 instances of perforation (Fig. 5).

Simple emergency closure, usually with omental patch, was performed in 39 cases with 12 deaths, or 30 per cent. Stafford noted 26 per cent mortality in this situation. This death rate was considerably higher than is encountered in the younger age groups. Death of 1 patient who refused operation added to the total. Two subtotal gastrectomies were done in the emergency and 1 local excision of ulcer, all in stomach cases, with survival. There was 1 late drainage of an abscess resulting from an unoperated upon perforation, and the patient did well. Later subtotal gastrectomy was performed on 4 patients (1 stomach), whose perforations had merely been closed in the emergency, and all made satisfactory recovery.

Obstruction of the stomach outlet produced retention of varying degree (Fig. 6). Twenty-five per cent retention was arbitrarily selected as the criterion for separate listing of this complication, since it was at about this level and above that significant

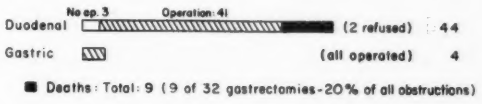

FIG. 6. Obstruction; retention 25 per cent plus.

clinical evidence, particularly persistent vomiting, began to be manifested. Here the pattern with respect to duration of symptoms was quite different. All but 2 of the 48 patients had histories of complaints of long standing. Of the 46 having symptoms for several years, 42 patients had duodenal ulcers and 4 gastric lesions. In fact 9 of the number had had previously repaired perforations, while 6 had undergone an earlier gastroenterostomy.

While retention did not constitute the acute emergency presented by hemorrhage or perforation, it could not, especially in the higher grades of obstruction, be tolerated for long by these elderly patients. Unlike bleeding there seemed little opportunity for medical management. Only 1 patient in the group was successfully treated by medical regimen. Two refused operation and were not improved. Surgery was the solution adopted for the remainder. Thirty-two subtotal gastrectomies were performed, 4 of them for stomach lesions, with 9 deaths. Thirteen gastroenterostomies were performed, with no fatalities. This record of 20 per cent mortality (28 per cent in gastrectomy) added some support to the inclination to employ the lesser operation in depleted elderly patients when the likelihood of later development of marginal ulcer might be largely discounted.

There were a number of patients with lesser gastric retention which could be classified under the general heading of in-

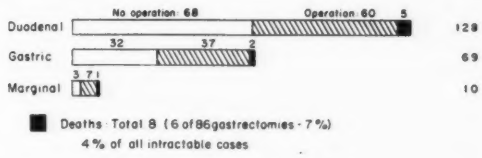

FIG. 7. Intractability.

TABLE I.—POSTOPERATIVE COMPLICATIONS

	Subtotal gastrectomy	*Gastro-enterostomy*	*Closing perforation*
Surgical			
Wound infection..	11	2	
Stump leak.....	11 (4)		
Intestinal obstruction.....	7 (3)	1 (1)	1
Wound dehiscence	4		
Phlebitis.....	3	2	1
Peritonitis.....	2 (2)		4 (4)
Hepatic abscess...	1 (1)		
Medical			
Cardiac accident..	5 (5)		8 (7)
Pulmonary embolism.....	3 (2)		
Pneumonia.....	2 (2)	1	3 (2)
Uremia.....	1 (1)		2 (1)
Mortality	(20)	(1)	(14)
Per cent.....	28	5	35

No. of deaths in parentheses.

tractability and some of these responded favorably to medical management. Intractability was the reason for a large number of admissions of peptic ulcer sufferers over 60 years old (Fig. 7). There were 207 cases thus classified (duodenal, 128; stomach, 69; marginal, 10). They were slightly fewer in number than the combined admissions for the emergencies of hemorrhage, perforation, and major obstruction (207 as compared with 223).

The complaints recorded for these intractable cases were of long duration. Pain was common to all in greater or less degree, often episodic in repeated exacerbations. In addition, 46 of the 128 duodenal and 24 of the 69 gastric ulcer patients had had periods of vomiting. Six additional stomach cases were complicated by duodenal ulcers as well. Five of the stomach ulcer patients had had previous operations: 3 closure of perforations, 2 wedge resection, 1 gastroenterostomy. Nine of the duodenal group had suffered perforations during their course.

Treatment of the 128 patients with intractable duodenal ulcers consisted in medical management alone for 68, and they responded satisfactorily. Many of them had never before undergone a careful medical regimen. Surgery was performed for the rest after a reasonable trial of conservative treatment. One antral exclusion was done with satisfactory result. There were 9 gastroenterostomies, done mostly in the earlier years of this study. One patient, who died of the complication, required a secondary entero-enterostomy for obstruction. In the remaining 50 subtotal gastrectomy was performed with 4 deaths ensuing.

Thirty-two of the stomach patients received medical therapy and responded. In 2 vagotomy alone was performed (1 suffered recurrence of ulceration), while 4 underwent gastorenterostomy. Thirty-one subtotal gastrectomies were done with 2 deaths. These cases included all those in which cancer was in question, particularly the gastric ulcers which resisted treatment or recurred after healing, as advocated by Smith and Jordan.

Patients with marginal ulcers comprised another group, 10 in number. All 10 complained of pain, 5 had vomited as well, while 8 had bled. The previous operations were: 8 gastroenterostomies (2 with vagotomy), 1 local resection, and 1 Billroth II. Three patients with marginal ulcers were medically treated and controlled. Five underwent subtotal gastrectomy successfully, 1 had an antral exclusion, while 1 bleeding patient had an ineffective exploratory gastrotomy and succumbed. The operative mortality for the cases in the category of intractability was 7 per cent, and the total rate 4 per cent.

The postoperative complications in all types of peptic ulcer proved more numerous and more lethal than in the younger patients (Table I). This factor required serious consideration in determining the management of the older patients. In 71 gastrectomies the following surgical complications were noted: wound infections, 11; stump leaks, 11 (4 deaths); obstructions, 7 (3 deaths); wound dehiscence, 4; phlebitis, 3; peritonitis, 2 (2 deaths); secondary hepatic abscess, 1 (1 death). The medical complications, even more to be dreaded, were: cardiac accidents, 5 (5 deaths); pulmonary embolism, 3 (2 deaths); pneumonia, 2 (2 deaths); uremia, 1 (1 death). The number of deaths was 20 (28 per cent mortality).

For the 40 operations of closure of acute

perforations, the surgical complications were: peritonitis, 4 (4 deaths); phlebitis, 1; wound dehiscence, 1. The medical complications were: cardiac, 8 (7 deaths); pneumonia, 3 (2 deaths); uremia, 2 (1 death); and delirium tremens, 1. The total number of deaths was 14 (35 per cent mortality).

Among the 23 patients who underwent a gastroenterostomy (including 4 with vagotomy) obstruction developed in 1 (1 death). In 1 of 2 pyloric exclusions postoperative bleeding occurred, in the other a duodenal fistula developed. No complications were noted in the few rarer procedures.

It seemed a reasonable conclusion from this survey of complications and mortality that the simplest operation which would meet the requirements of life-saving or relief was to be preferred; and that the objective of treatment might well be safety and survival rather than long range perfection of result, particularly if that aim required a more elaborate and more immediately hazardous procedure.

In this study no attempt has been made to evaluate, by means of long range follow-up, the ultimate efficacy of the various treatments employed. It has been noted that many of the patients had had previous ineffective operations at this hospital and elsewhere during their earlier years; and it was reasonable to assume, even though the histories did not always specifically record it, that most of them had had intermittent periods of medical therapy, also ineffective. What, then, were the results of this latest therapy? The records were meager, but all of these except the patients who died or left without treatment were reported in satisfactory condition on discharge. Later results from 1 to 14 years after treatment were recorded for 80 of the surgical cases as being entirely satisfactory as far as freedom from digestive disturbance was concerned. Nine patients who were well a year after operation later died of unrelated diseases. Thirteen had recurrence of symptoms and 2 treated by partial gastrectomy reported dumping syndrome.

Of those treated without operation 32 were reported to have no digestive complaints 1 year or more after discharge. Five later died of other diseases. Nine patients were recorded as having died within 6 months after discharge (7 surgical and 2 medical cases), 7 of them from heart disease, 1 from cancer, and 1 from a stroke. Whether any of these accidents were precipitated by the ulcer episode was problematical.

The impression emerging from this study was the futility of drawing general conclusions and attempting to apply them to evaluation, management, and prediction in the individual case. So many varied factors played their parts in modifying the situation in the elderly patient that each case became a distinct problem in itself.

COMMENT

In this study it was noted that while peptic ulcers most commonly developed in the middle years of life they often persisted in spite of medical and even surgical treatment and were tolerated until the later years. Nearly one-fifth of all ulcer patients admitted were over 60 years of age. They had suffered such distress or such serious complications had developed that they sought hospital care for relief.

It was observed that relatively few ulcers developed for the first time after the age of 60 and that these often manifested themselves by severe hemorrhage or by perforation either with symptoms of short duration or sometimes without premonitory complaint.

The most frequent of the late complications of ulcer creating a true emergency was hemorrhage, and in a fair proportion of cases bleeding had occurred before, perhaps periodically, over a period of years. Those cases in which bleeding was the first ulcer symptom occurring after the age of 60 were likely to be particularly severe and dangerous.

It was noted that perforation of stomach or duodenum was the second serious emergency in point of numbers and that it usually

occurred in old and chronic cases of ulcer and less frequently as the result of late-developing ulceration.

It was shown that obstruction of the stomach, while a less acute emergency, still demanded active treatment for relief if the patient were to survive and it was observed that those patients almost without exception, had long-standing ulcer complaints.

There was a final and larger group of patients with symptoms of many years' duration whose tolerance had been exhausted and who sought relief from the intractability of the ulcers.

As to treatment in these older patients, it was demonstrated that many cases of hemorrhage, especially if massive or recurrent, demanded surgical intervention. It was also true that when the conditions were favorable and the circumstances warranted, the operation of subtotal gastrectomy was justifiable and safer than permitting continuance of bleeding, and in the great majority of such cases it was successfully undertaken.

It was shown that perforation of the stomach or duodenum demanded surgery and that, in this age group, the operation of simple closure was the safest.

In obstruction and intractability, unless the patient's status was favorable and there was reasonable assurance of the safety of subtotal gastrectomy in the individual case, it seemed best to be content with the employment of a less hazardous, if less ideal, procedure except when cancer was seriously suspected.

Finally, it was noted that in hemorrhage unless massive and continuing or recurrent, in obstruction of moderate degree, and in many cases of intractability—in all types of complication, that is, except perforation—the results of medical therapy, as distinct from surgery, were by no means to be despised. The success of skilled medical care in many of these older patients was a matter of record and well warranted its continued judicious employment.

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CYTOLOGIC-COLPOSCOPIC OBSERVATIONS OF THE ECTOCERVIX OF PREGNANCY

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THE EPITHELIA of the ectocervix along with the other derivatives of the muellerian system, respond to the hormonal, vascular, and other growth stimuli of pregnancy. These changes have been described in many articles dealing with the histologic aspects of both the normal and abnormal pregnant cervix. The cytology of the vagina in pregnancy has also been the subject of considerable investigation. Not as much attention has been given to the corresponding cytologic changes of the pregnant ectocervix; also, very little has been written of colposcopic patterns in pregnancy.

Since 1944, at which time a cytology laboratory was established at our institution, we have had the opportunity of examining vaginal and cervical smears from over 10,000 pregnant women. For the past 18 months we have attempted to study a series of cases in which the portio of the pregnant cervix was evaluated by cytology, colposcopy and, when necessary, biopsy. It is this series of cases which form the basis of this survey.

METHOD OF STUDY

Our patient material consists of a total of 300 women evaluated by both cytologic and colposcopic techniques. Approximately four-fifths the patients were nonwhite; all patients were from the obstetric ward and outpatient services. One hundred ninety-eight women were seen during various stages of normal intrauterine pregnancy; 81 other women were examined in the immediate postpartum period (median time after delivery 40 hours); 21 were studied just before or after a spontaneous abortion. The median age of all patients was 27 years. Some of the normally pregnant women were chosen more or less at random; the majority were seen because of abnormalities noted grossly, and occasionally because of an abnormal cytologic smear. Frequent biopsies were taken, either in the clinic, or, in a few cases, after admission to the ward. Most biopsies were selective spot biopsies with the exact site determined by the aid of colposcopic examination.

Cytologic specimens were obtained both by vaginal aspiration of the posterior fornix and by cervical scraping. The smears were promptly fixed in equal parts of 95 per cent alcohol and ether, and then stained by the method of Papanicolaou. During pregnancy the succulence of the cervix and the increased cellular desquamation tend to provide numerous cells for study.

The principles of colposcopy and the performance of a colposcopic examination have been previously detailed(1). The instrument itself is fashioned to provide stereoscopic inspection of a well illuminated cervix at a magnification of 10 times. Three per cent aqueous acetic acid is applied to the portio to increase detail. Aqueous iodine solution in the form of liquor iodii compositus (U.S.P.) (Lugol's solution) is applied as a surface vital stain to detect iodine-nonstaining areas (Schiller test). Since the vaginal sidewalls, especially near the introitus, tend to lose their normal tissue rigidity in pregnancy, we have found it helpful to cover the bivalve speculum before insertion with a perforated finger cot to allow direct, adequate, visual access to the portio.

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TABLE I.—ATYPISMS IN PREGNANT CERVICES

Colposcopy	*Cytology*	*Histology*
Leucoplakia (7 cases)	All class I	1 regressed without biopsy 1 BCH
Mosaic leucoplakia (6 cases)	5 class I	2 BCH
	1 class II	Trichomonas vaginalis; biopsy negative
Ground leucoplakia (3 cases)	All class I	All normal
Inflamed transformation zone (4 cases)	2 class I	1 BCH
	1 class II	Trichomonal vaginitis (no biopsy)
	1 class II	Severe inflammation by biopsy
True erosion (2 cases)	Both class I	1 BCH

RESULTS

Pregnancy effects in general. The major effect of pregnancy on the cervix is that of hyperplasia (Fig. 1). A previous report from this institution, by Murphy and Herbut, has described the hyperplasia of the columnar and squamous epithelium, the epidermidalization, inflammatory changes, decidua formation, increased basal cell activity, edema, and increased vascularity which may occur. In fact, the squamous epithelium may proliferate to such a degree that the surface seems wrinkled colposcopically; it may even become papillomatous. We have had 4 such cases, all with normal cytologic smears. Cervical glandular epithelium becomes polypoid in nature as it becomes hyperplastic; and, as a result, cervical polypi are frequent in pregnancy. Ten of our patients had grossly visible polyps; tiny polypoid structures were frequently noted colposcopically. Squamous covering (epidermidalization) of a polyp may also be recognized as such by colposcopy. Epidermidalization of cervical polypi may be associated with benign atypias by smear.

The general vaginal cytologic picture of normal pregnancy is well known. Essentially, the cytologic pattern reflects the effects of a combination of estrogen and progesterone such as is seen in the corpus luteum phase, except that with pregnancy, there is a marked increase in desquamation. There is consequently a predominance of folded precornified cells and intermediate cells in clumps. The navicular cells have nuclei which are rather elongated. Glandular cells, when present, frequently demonstrate nuclei that may seem more active than in nonpregnancy.

Cervical erosion. A common difficulty encountered in the cervix of pregnancy is the assessment of a cervical "erosion," a reddened, velvety area located more or less concentrically around the anatomic external cervical os. A cervical erosion in pregnancy appears redder, more succulent, and is more friable than in the nonpregnant patient.

In pregnancy the colposcopic picture of a cervical erosion is identical to that described in benign erosion of nonpregnant women(2). The "erosion" consists of a rim of columnar epithelium (ectopy) encircling the os. Just peripheral to this is a transformation zone: an area of squamous epithelium containing glandular elements in the form of islands, and gland openings or nabothian cysts. The presence of this zone is statistically related to increasing parity and perhaps also to age. Neither the erosion of pregnancy or nonpregnancy is characterized by a true loss of surface epithelium.

Just as the average cervical erosion is essentially normal by colposcopic inspection, so is it usually associated with a normal cytologic smear. Squamous elements greatly outnumber glandular elements on the smear, perhaps because the latter do not desquamate as easily. With epidermidalization or inflammation, cytologic atypias may be noted which are of the benign type and generally classified as class II.

Vaginal infections. The vaginal surface of the cervix becomes inflamed in the presence of severe trichomonal or candidal vaginitis. The "salt and pepper," "measles," or "strawberry" appearances of the former are found in symptomatic cases. Clusters of dilated capillaries with or without a necrotic center are seen colposcopically in trichomonal infections. In the presence of either Trichomonas vaginalis or Candida the squa-

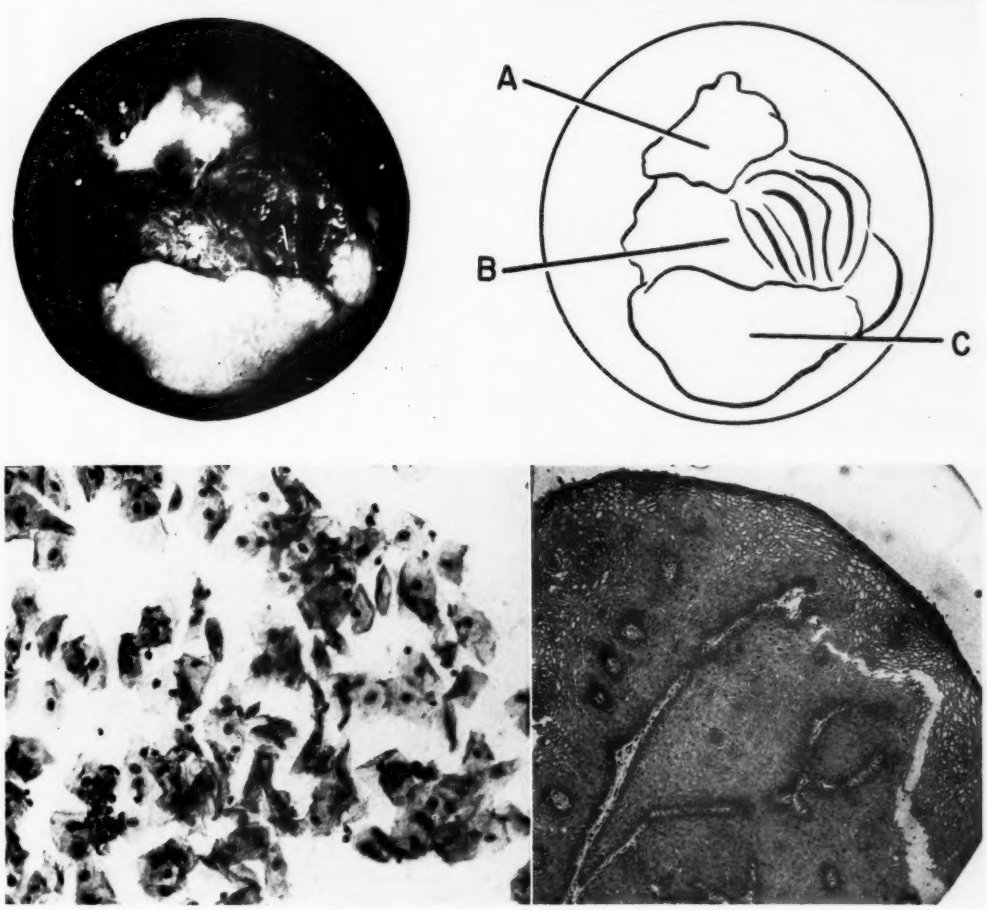

FIG. 1. Colpophotograph, explanatory diagram, cytologic smear, and biopsy of D. B., 15 year old negress, gravida 1, para 0, seen at the seventh month of pregnancy. The colpophotograph shows: *A*, mucus at the cervical os, *B*, columnar epithelium with noticeable proliferative change on the viewer's right, and *C*, a papillomatous lesion of the cervix. Cytologic smear was negative (only squamous cells visualized). Biopsy disclosed a cervical squamous cell papilloma.

mous epithelium may respond with localized elevated areas of whitish appearance.

As others have reported, vaginal infection with Trichomonas vaginalis may produce changes in the surface epithelium. The smear may then demonstrate dyskaryosis and perinuclear halo formation. We believe this reaction to be found more frequently in the pregnant than the nonpregnant patient. In our experience, candidiasis does not seem to modify the cells as visualized by smear.

Postabortal, postpartum cervix. The immediate postabortal or postpartum cervix is infrequently visualized. The colposcopic changes found form the basis of a separate report(3). Grossly, the cervix at this time resembles the cervix during pregnancy except that it is dilated and shows evidences of trauma such as laceration, true erosion, and ecchymosis. After delivery the cervix contracts fairly rapidly so that by 48 hours the os is nearly normal in size.

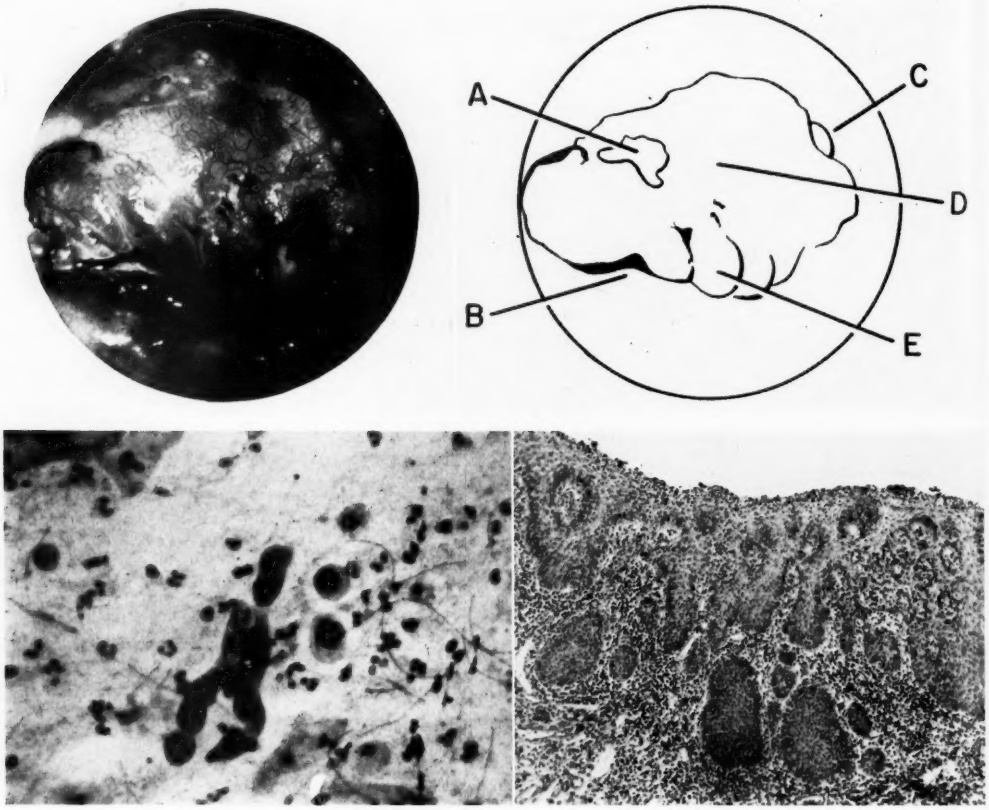

FIG. 2.

(*Legend on facing page.*)

Briefly, it may be stated that the cervix at this time shows areas of epithelial denudation only several millimeters in diameter. As the cervix contracts, the lacerations, which may occur at any site, seem also to become smaller. The cervix may demonstrate a bruising of the anterior lip. The postabortal cervix shows similar but less marked evidences of trauma.

In the postabortal or postpartum period the smear contains many red cells, leucocytes, and cells of intermediate cell layers. Decidual and syncytial cells of placental origin may be seen; histiocytes appear in several days. Histologically, edema, congestion, and extravasations of blood are common.

Atypisms. Colposcopic atypisms (without cancer) were noted in 22 instances (Table I). Iodine-nonstaining areas are not included in the table since the Schiller test was not performed in all cases. As is well known, however, the squamous epithelium in a transformation zone frequently does not stain with iodine. In all cases of atypism, except 1 of simple leucoplakia (which regressed postpartum) and 1 inflamed transformation zone, biopsy was performed. The predominant findings in each case of atypism were simple leucoplakia, 7 times; mosaic leucoplakia (whitening with a mosaic pattern), 6 times; inflamed transformation zone, 4 times; ground leucoplakia (whitening with

FIG. 2. Colpophotograph, explanatory diagram, cytologic smear, and biopsy of V. D., a 23 year old negress, gravida 3, para 1, 2 months pregnant. Grossly, the cervix was thought to show an "erosion." There were no unusual symptoms. The colpophotograph shows: *A*, simple leucoplakia, *B*, external os, *C*, nabothian cyst, *D*, mosaic leucoplakia and, *E*, proliferation of squamous epithelium. The cytologic smear was classified as Papanicolaou class II. Mycotic elements are seen. Biopsy (tangential cut) was interpreted as demonstrating hyperplastic squamous epithelium.

FIG. 3. Colpophotograph, cytologic smear, and biopsy of V. H., a 37 year old negress, gravida 3, para 2, 4 months pregnant, whose chief complaint was that of vaginal discharge. There was no history of bleeding during pregnancy. A whitish proliferative lesion was noted grossly. By colposcopy, proliferation with simple leucoplakia was seen. At the edge of the lesion (not in photograph), mosaic leucoplakia and abnormal blood vessels were noted. Papanicolaou smear was classified as IV. Biopsy showed invasive squamous cell carcinoma.

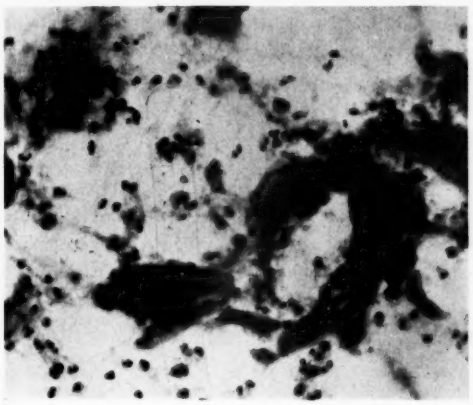

FIG. 3.

a stippling of red spots), 3 times; and true erosion, 2 times. The smear was class I in 19 instances, class II in 3 cases (inflamed transformation zone with trichomoniasis, no biopsy; mosaic leucoplakia with trichomoniasis, negative biopsy; and severely inflamed transformation zone, biopsy showed inflammatory changes). There was no abnormal smear without some colposcopic changes. Increased basal cell activity was found in 5 spot biopsies (all with negative smear); the respective colposcopic patterns were mosaic leucoplakia twice, 1 case each of simple leucoplakia, marked true erosion and markedly inflamed transformation zone. It should be stressed that these cases were not chosen at random but represent a selected study group. An example of colposcopic and cytologic atypism is demonstrated in Figure 2.

Carcinoma. In our series is included 1 case of carcinoma in situ treated in January 1956. This particular woman, a 35 year old negress, gravida 2, para 2, had had 2 episodes of menorrhagia. The cervix was "eroded" clinically. The smear was classified as III; colposcopy disclosed mosaic and ground leucoplakia. An extensive circular biopsy was performed and carcinoma in situ diagnosed histologically. The patient was observed carefully. She became pregnant in June 1956. Papanicolaou smear and colposcopy remained negative during pregnancy.

Biopsy of an iodine nonstaining area was negative. The patient delivered easily vaginally. To date, cytologic smears and colposcopic examinations have been normal.

There were 2 cases of invasive carcinoma. One was a 37 year old negress, gravida 3, para 2, whose chief complaint was vaginal discharge. A condyloma-like lesion was seen clinically. Cytologic smear was class IV; colposcopy showed proliferation, ulceration, and abnormal blood vessel formation; simple leucoplakia was evident at the edge of the lesion. Biopsy showed invasive squamous cell carcinoma. The lesion was listed as stage I (Fig. 3).

The other case was of a 23 year old white woman, gravida 3, para 0, who noted vaginal bleeding during the fourth month of gestation. A proliferative lesion was seen clinically. Cytologic smear was class III; colposcopy disclosed ulceration, proliferation, and abnormal blood vessel formation. Biopsy was taken and the lesion was reported as squamous cell carcinoma of the cervix. The lesion was classified as stage II.

DISCUSSION AND SUMMARY

Gross inspection of the cervix during the pregnant state, even more so than during the nonpregnant state, affords only a rough estimate of the true nature of the cervical changes seen. Colposcopy, which provides a more detailed view of the cervix in the living state, complements cytology, which evaluates the cells shed from the cervix. Colposcopy demonstrates the overgrowth of epithelium and aberrations of surface architecture; cytology mirrors the hormonal pattern and individual cellular structure.

Cytology lends itself well to the routine screening of the pregnant cervix. Colposcopy is of value in further studying those patients in whom gross changes are noted by speculum examination or those who have an abnormal smear. For practical reasons such as time and availability of colposcopically trained professional personnel, colposcopy does not lend itself to a routine screening program. From an academic standpoint both cytology and colposcopy provide diverse yet complementary data concerning the uterine cervix of pregnancy.

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EXPERIENCE WITH SHUNTING PROCEDURES FOR PORTAL HYPERTENSION

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FORTY PATIENTS were operated upon for portal hypertension between April 1949 and June 1957. The number of patients reported upon is comparatively small, yet it includes a considerable diversity in the pathologic conditions for which the shunts were performed. In all but 3 patients, it was done to prevent severe recurring gastrointestinal hemorrhages. The remaining patients were operated on for marked splenomegaly. This was associated with hypersplenism, pupura, and ascites in 2 and no symptoms in 1. A splenorenal shunt was performed in each of these cases because of a portal pressure in excess of 400 millimeters of saline in spite of no history of bleeding.

Splenorenal or portacaval shunts were performed in 27. A shunt was considered impossible or contraindicated in the remaining 13 patients. Several in this group could probably have been treated with increased experience.

In the shunted group, Laennec's cirrhosis was responsible for the portal hypertension in 20 of the 27 patients. One of these had an associated Cruveilhier-Baumgarten syndrome. Two of the 7 remaining patients had postnecrotic cirrhosis, 1 had biliary cirrhosis, 1 had schistosomiasis involving the liver and spleen, 1 had Boeck's sarcoid involving liver and spleen, and 1 had a granulomatous inflammation with necrosis involving liver and lymph nodes that may have been Boeck's sarcoid. There was only 1 example of an extrahepatic block, presumably due to postoperative changes in the right upper abdomen in an older man. Portal venograms disclosed an extrahepatic narrowing of the portal vein to 3 millimeters while the liver was shown to be normal by biopsy.

Splenorenal shunts, end-to-side, were constructed in 15 of this group. Portacaval shunts were performed 12 times, side-to-side in 4, by means of a femoral vein graft in 6, and end-to-side in 2.

The reasons for not performing a shunt are worth reporting to illustrate the problems encountered. In 2 patients in the unshunted group a splenorenal shunt was abandoned because of marked adherence of the vessels in the splenic pedicle secondary to old pancreatitis. Both patients were seen early in the series and might have been successfully operated upon with increased experience. One of these patients had obvious Laennec's cirrhosis at the time of surgery and succumbed to recurring hemorrhages after 2 years. The other patient had what appeared to be a normal liver at surgery with progressive changes in his blood chemistry over a 6 year period, suggesting cirrhosis. During this time recurring severe hemorrhages have been successfully treated with a Sengstaken-Blakemore tube as he has refused further surgery.

In 2 patients no demonstrable portal hypertension existed at the time of surgery in spite of splenomegaly and gastrointestinal bleeding. Portal pressures measured in the coronary vein in one and in an omental vein in the other, with the zero point of the manometer at the level of the portal vein, were 115 and 100 millimeters of saline, respectively. One of these patients had severe cirrhosis and died in coma following recurrent severe bleeding approximately 1 month later. The other had no demonstrable splenic vein at surgery. He continued to

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bleed and postmortem examination approximately 18 months later disclosed thromboangitis obliterans of the coronary, celiac, splenic, hepatic, pulmonary, and adrenal arteries with a patent portal vein and no esophageal varices.

Four patients had no available vessels for the construction of a shunt at the time of surgery. Two of these had had previous splenectomies for extrahepatic portal block with recanalization of the portal and superior mesenteric veins. One of these subsequently required suturing of the esophageal varices for severe bleeding. The other was lost to follow-up after 6 months during which time he did not bleed. A third patient, with intrahepatic block, had a recanalized portal and superior mesenteric vein with a spleen that was almost completely adherent to the anterior and lateral abdominal wall as well as to the diaphragm by broad vascular adhesions. A splenorenal shunt was abandoned as too hazardous. He succumbed to hemorrhage and coma 2 years later after resuming heavy drinking. Initially an exploratory operation was performed upon the fourth patient for a bleeding peptic ulcer, and he had a portal pressure of over 600 millimeters of saline with a liver which appeared normal. The splenic artery was ligated. When a splenorenal shunt was attempted a month later the splenic vein was thrombosed and the portal pressure had fallen to 335 millimeters of saline. There has been no further bleeding in almost 2 years of follow-up.

Three patients with severe cirrhosis associated with active bleeding merely had arterial ligation, in one case splenic plus omentopexy, in one case splenic and left gastric, and in the last splenic and hepatic arteries. All 3 patients continued to bleed and died in 1, 13, and 18 months, respectively. At present all of these patients would be treated by transesophageal ligation of their varices.

In 1 patient a splenorenal shunt had to be abandoned because of hypotension. Portal venograms disclosed an intrahepatic block thought to be due to tumor. Thorotrast studies showed this tumor to be increasing in size when the patient was last seen 6 months later.

The final patient in this group is included only as an example of inadequate surgery in attacking the varices directly. The patient had survived 11 days in hepatic coma with bleeding controlled by a Sengstaken-Blakemore tube, but bled again 9 days later. On transthoracic approach there were numerous dilated veins running on the external surface of the lower esophagus, including what appeared to be a continuation of the coronary vein above the diaphragm which measured 1 centimeter in diameter. The lower esophagus was cleared of veins without opening it. The patient bled to death 4 days later from erosions in the stomach and esophagus.

TREATMENT OF THE ACUTE BLEEDING EPISODE

The successful treatment of the acute bleeding episode in a patient with esophageal varices may be easy if the hemorrhage stops promptly with or without treatment and does not recur. Frequently, however, it is one of the most difficult acute conditions which a doctor must treat. In this present study the initial means of controlling the bleeding was the Sengstaken-Blakemore tube. This was adequate to stop exsanguinating hemorrhage in most cases when it was properly in place and inflated to an adequate pressure. It was found better to insert the tube on the strength of a competent history, however, and not to inflate the esophageal balloon or apply traction initially rather than to try to insert the tube later during a severe hemorrhage. The tube functioned as a diagnostic tool in cases of patients treated without previous workup. It did not invariably completely stop the bleeding, however, and the incidence of recurrent bleeding after deflation of the esophageal balloon was high. It was interesting to read Blakemore's comments in discussing Cohn and Mathewson's paper concerning a manufacturing error in the

thickness of the esophageal balloon to which he attributed such failures (4). Use of the tube alone controlled the acute bleeding episode long enough to permit definitive surgery in less than half of the patients in whom it was used. Recurrent bleeding with eventual hepatic coma and death took place in the majority of patients so treated.

In view of these poor results, suitable patients have recently been treated by means of transesophageal ligation of the varices as advocated by Linton and Warren (7). This procedure, however, is a major operation which may be associated with furious bleeding. Jaundiced patients with ascites and early signs of coma have not been thought to be suitable candidates for it. Too often the golden opportunity for performing this operation seems to be lost by allowing the patient to bleed repeatedly at home or even in the hospital if the history is not given sufficient credence. The hemorrhage has been immediately arrested in the patients in whom the operation has been employed. One of these patients upon whom an exploratory operation had been previously performed without the discovery of a suitable vein for a shunt represents an extrahepatic block. Upon x-ray examination his varices are seen to have returned, and he has had several minor hemorrhages in the 2 years since his esophageal operation. There has been no mortality so far among the 3 patients chosen for this procedure. The incidence of serious ascites postoperatively delaying the definitive shunting procedure has been high.

Rehabilitation after a major hemorrhage in a cirrhotic patient is frequently slow even if emergency surgery is not necessary to arrest the hemorrhage. If a Sengstaken-Blakemore tube is necessary, feeding should be started through it as soon as the hemorrhage is controlled and the gut cleared of blood by the use of cathartics and neomycin. In general, at least a month of treatment with a 10 to 20 milliequivalent sodium moderate protein diet, rich in iron and vitamins, as advocated by Habif and associates, has been employed prior to shunting. Small paracenteses plus the use of salt-poor human albumin have seemed to help in decreasing ascites. Too few patients developing hepatic coma after their hemorrhage have been treated with glutamic acid to evaluate this form of therapy, and none has been treated with arginine. In general, the criteria of operability suggested by Linton (6) have been adherred to as far as liver function tests are concerned. Patients have not been judged ready for a shunting procedure until their jaundice and most, if not all, of their ascites have disappeared, the serum albumin level has been 3 grams per cent or better, the bromsulphalein retention not over 25 per cent, and hemoglobin 10 grams or more. Frequently, the cephalin flocculation has been 3 and 4 plus.

CHOICE OF THE SHUNTING PROCEDURE

The choice between performing a left-sided splenorenal shunt or a right-sided portacaval shunt is frequently a matter of the individual preference and experience of the surgeon. In some patients, however, this is a critical decision if a useless and at times fatal operation is to be avoided.

There are certain general considerations which help this selection. If the spleen is large, the splenic vein is usually adequate for the performance of a splenorenal shunt, and there is often some degree of hypersplenism which responds promptly to splenectomy. Previous laparotomy or thoracotomy scars should suggest the choice of the opposite side if possible in order to avoid extensive vascularized adhesions which make the operation tedious and at times hazardous. The history of acute inflammatory processes such as duodenal ulcers should also suggest choice of the opposite side to avoid adhesions and a possible thrombosed portal vein. The left-sided splenorenal shunt is probably safer with proper selection as there is less danger of injury to vital structures, such as the common bile duct and hepatic artery, as well

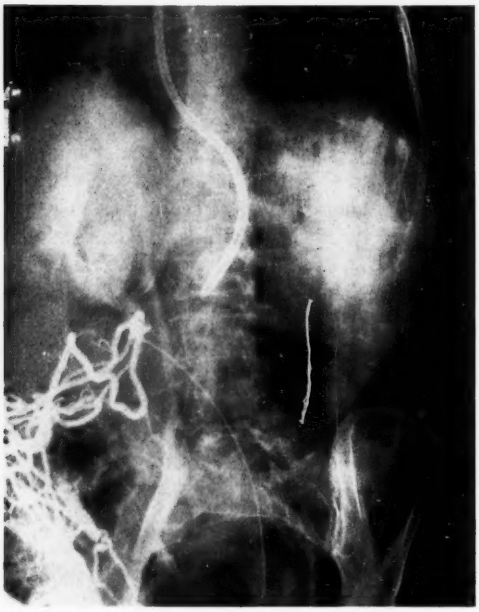


FIG. 1.

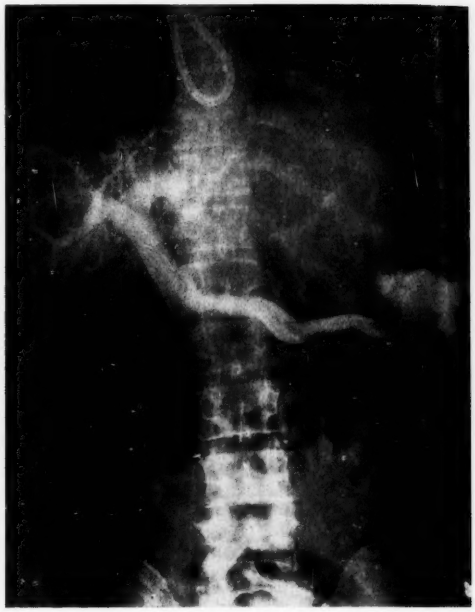


FIG. 2.

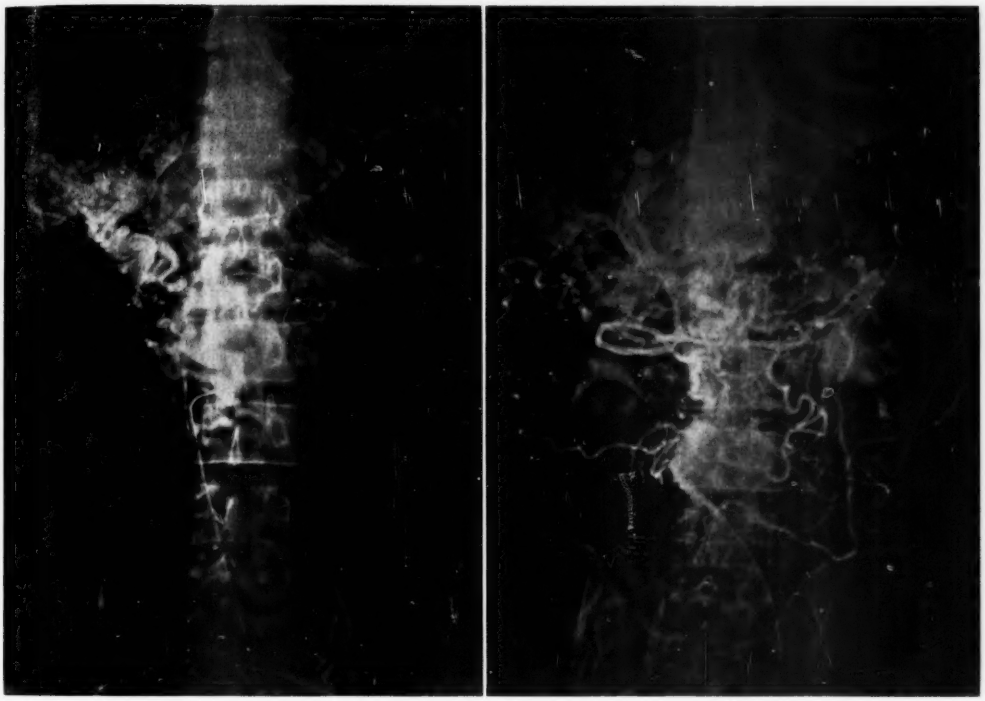
FIG. 1. Portovenogram through an omental vein showing abundant collateral circulation by way of round ligament of the liver and right external iliac vein.

FIG. 2. Splenoportogram showing large patent portal vein with fairly normal intrahepatic arborization.

as less interference with collateral circulation which may be extensive by way of the round ligament of the liver (Fig. 1). The kidneys should be demonstrated by pyelography before planning a splenorenal anastomosis.

Splenoportograms and portovenograms are of great assistance in the selection of the most suitable shunt by actually visualizing the portal vein and its tributaries. If the spleen is palpable, a splenoportogram can be performed safely and easily by inserting a No. 18 lumbar puncture needle into the spleen through the left eighth interspace in the midaxillary line and injecting 30 cubic centimeters of a 70 per cent aqueous contrast material. This may be done after the patient is anesthetized for surgery in order to lessen the chance of laceration of the spleen from respiratory motion. Without a rapid cassette changer only 1 film is usually possible toward the end of the injection (Fig. 2).

If the spleen has been previously removed or is very small, a splenoportogram may be performed under direct vision during operation or it may be decided to utilize a portovenogram. After opening the abdomen with an upper transverse incision, this may be performed by inserting a fine polyethylene catheter either into an omental vein or into one of the upper jejunal arcades. Due to the absence of valves in the portovenous bed, this catheter may be used both for the measurement of portal pressure and the injection of contrast material. The amount of contrast material injected should be kept to the minimal effective amount as it usually produces a moderate transitory hypotension. Following splenectomy, it may be important to use both routes of injection in order to avoid overlooking a suitable vein for shunt (Fig. 3). Failure to visualize the portal vein constitutes obvious evidence of portal vein thrombosis or recanalization and contraindicates time-consuming dissec-



a b

FIG. 3. a, Portovenogram through an omental vein showing collateral vessels obscuring the portal vein. b, Portovenogram through arcade of upper jejunum showing block in portal vein. Note contrast media in renal pelves and no splenic vein.

tion of this vessel. The portal vein may seem to visualize normally at times even when a partial thrombosis is present. After deciding on the type of shunt the patient may be repositioned with either side up and the transverse incision converted into a thoracoabdominal one.

Portacaval shunts. The technical performance of a portacaval shunt is certainly easier than that of a splenorenal shunt as the vessels are larger and considerably thicker. The shunt also is larger and reduces the portal pressure more effectively, particularly if performed in an end-to-side manner. There are theoretic objections to an Eck fistula, however, with experimental evidence in dogs that the liver deprived of portal blood will not regenerate as shown by Child and Mann.

An alternate way to perform a portacaval shunt is side-to-side, either directly or with the interposition of a segment of superficial femoral vein as an H graft. Regenerating liver frequently causes too great a separation of the portal vein and vena cava for direct anastomosis without undue tension. A vein graft with 2 suture lines was necessary in over half of the side-to-side anastomoses in the present study. In 1 case segments of femoral veins from both legs had to be joined to bridge the gap with thrombosis resulting at the central suture line. Regional heparinization by means of a polyethylene catheter tied into an omental vein has been considered necessary for 5 or 6 days postoperatively when grafts have been used. Overheparinization can produce troublesome hemorrhage into thoracic and abdominal cavities at times.

Linton (6) claims that a side-to-side

portacaval anastomosis does not contribute portal blood to the liver and may even permit hepatic artery blood to be lost in a retrograde fashion. If this is so, it should be true to some degree for splenorenal anastomoses as well since there are no valves in the portal system. From the evidence of portovenograms, however, it would seem that there are considerable variations in the amount of portal blood getting through the liver in cirrhosis. No deleterious effects have been observed from the use of side-to-side or H graft anastomoses in the present study.

One additional problem in the performance of a portacaval shunt is the number and size of the lymphatics in the porta hepatis in cirrhosis. Grindlay (9) has stated that lymph flow is increased in experimental cirrhosis in dogs by 545 per cent. At times it becomes necessary to aspirate lymph continuously in order to see the operative field.

Splenorenal shunts. When the spleen is large, the splenic vein is usually of sufficient size for an adequate shunt. This fact should be checked by splenoportogram. The wall of this dilated vein may be excessively thin, however, and there may be little of it free beyond the tail of the pancreas. Mobilization of additional splenic vein is time-consuming because of numerous thin walled tributaries from the pancreas. After such mobilization, especially in a large vein carrying a high pressure, sharp angulation may occur when the splenic and renal veins are approximated. This may be minimized by rotating the splenic vein 45 degrees in a clockwise direction before anastomosis which has the effect of banking the turn.

Inflammation either recent or remote may make the splenorenal anastomosis very difficult or impossible. This may take the form of a pancreatitis with resulting adherence of the vessels in the splenic pedicle, or it may be present as a marked perisplenitis with broad, extremely vascular adhesions to the diaphragm, lateral abdominal wall, as well as to the abdominal viscera.

Twice in the present study the left renal vein was bifid almost up to its junction with the vena cava. An anastomosis to half the renal vein is not adequate so that extensive mobilization of the splenic vein may be required in such cases.

Postoperative venograms in patients receiving regional heparinization through a polyethylene catheter in an omental vein invariably showed the contrast material going toward the liver rather than through the splenorenal shunt. This fact suggests that the liver has an opportunity to deaminate the portal blood, but it also gives rise to some speculation concerning the adequacy of the shunt. It has not been the practice to use regional heparinization in splenorenal shunts since the early part of the study and not in portacaval shunts unless a vein graft was used or a partial thrombosis of the portal vein was found at operation.

In general, the postoperative morbidity has been lower following splenorenal shunts.

OPERATIVE PROCEDURE

Anesthesia. The proper choice of anesthetic agents for the performance of portacaval shunts is of the greatest importance since most candidates for this procedure have little or no hepatic reserve. The prolonged surgery is not uncommonly followed by some degree of jaundice and ascites. This was especially true during the first years of the present study when endotracheal nitrous oxide, oxygen, and ether were used. There was much less evidence of liver damage by function test and by development of jaundice and ascites when the anesthetic agent was shifted to nitrous oxide or cyclopropane and a relaxing agent such as anectine or flaxedil. The patients were awake promptly even after prolonged surgery and had fewer complications. There has been no experience in the present series with hypotensive anesthesia either by the spinal technique of Gillies or by the use of autonomic blocking agents.

Operative technique. A thoracoabdominal

incision either right or left with division of the diaphragm back to its ligamentous portion was used in all but 2 cases in the present series. In the earlier cases a rib was removed, but this procedure was avoided later by an intercostal incision in the seventh or eighth interspace with removal of approximately 1 centimeter of costal cartilage to facilitate closure. The intercostal incision was continued as a transverse abdominal incision across one or both recti. In 2 patients with wide costal angles portacaval shunts were performed through subcostal incisions. Both patients were large and moderately obese. The avoidance of a thoracic incision was outweighed by the increased difficulty of exposure. In several patients, a transverse abdominal incision was made initially and converted into a right or left thoracoabdominal one on the basis of exploration and portovenograms. Underwater chest drainage was routinely instituted upon closing the chest after several experiences with hemothorax.

Splenorenal anastomoses were performed in an end-to-side manner with a continuous everting mattress suture of No. 5-0 arterial silk interrupted at both ends of the suture line. The left renal vein was mobilized and a segment of the anterior wall drawn into a modified Potts clamp for anastomosis. On several occasions the renal vein was so thin walled that there was some bleeding through the anastomosis clamp. Once the traction sutures used to lift a segment of renal vein into the anastomosis clamp cut through the thin walled vein, but it was possible to grasp the vein blindly and accomplish a satisfactory anastomosis. The left renal artery was not occluded even temporarily. As mentioned previously, the splenic vein was rotated clockwise 45 degrees to bank the turn into the renal and prevent angulation when this seemed to be a problem.

Portacaval anastomoses were likewise accomplished with a continuous everting mattress suture of No. 5-0 arterial silk interrupted at both ends of the suture line. When the portal vein and vena cava could be brought together without undue tension, suitable segments of both vessels were drawn into a Smith-Freeman anastomosis clamp and elipses 1.5 to 2 centimeters in length were cut from both vessels. If the vessels were separated by interposed liver and could not be approximated, which was true in over half of the cases, a segment of superficial femoral vein as a free graft was inserted between them, end-to-side into the portal, and end-to-side into the cava. It was not necessary to free the portal vein completely in order to draw a suitable segment into a Potts anastomosis clamp. As mentioned previously, in 1 instance the separation of the vessels was great enough to require 2 superficial femoral vein grafts to be sewn together with resulting thrombosis at this third suture line.

On 1 occasion a thrombus was found partially occluding the portal vein in spite of a portovenogram which appeared to show a portal vein with normal contours. An end-to-side portacaval shunt had been elected in this patient. It was easy to separate the thrombus from its attachment to the anterior wall of the portal vein up to the anastomosis clamp. After the release of the clamp, the thrombus could no longer be visualized but was cleared with gentle curetting with a pituitary spoon. Regional heparinization was employed through a small polyethylene catheter tied into an omental vein for 3 weeks postoperatively in an effort to prevent rethrombosis. It is too early to evaluate the long term result in this patient, but he has had no further gastrointestinal bleeding in 7 months since surgery.[1]

After the early part of the study, regional heparinization was used only when a vein graft was necessary. An attempt was made to introduce precisely 100 milligrams of heparin every 24 hours. This was dissolved in 1,000 cubic centimeters of 5 per cent dextrose containing 600,000 units of penicillin and given through a catheter in an

[1]This patient died suddenly 8 months postoperatively, and at autopsy had a well healed patent shunt and massive coronary thrombosis.

omental vein. Oxygen pressure with a mercury trap and a second bottle of heparin solution in tandem was used to establish a fairly even rate of flow not dependent on respiration or position in bed. On 2 occasions, a patient became generally heparinized with resulting hemorrhage into the thoracic and abdominal cavities.

RESULTS

Between January 1950 and June 1957, 26 shunts were constructed for portal hypertension due to intrahepatic portal block and 1 due to extrahepatic obstruction. Twelve of these were portacaval, 4 of them side-to-side, 2 end-to-side, and in the remaining 6 an interposed segment of femoral vein was used as an H graft. Fifteen splenorenal anastomoses were performed in an end-to-side fashion, in 1 case to the upper half of a bifid renal vein. All of these patients have been followed-up for from 1 to 6 years except for the last 3 in whom the follow-up period does not exceed 6 months.

Operative mortality. There were 2 operative deaths in the series, an operative mortality of 7.4 per cent. Both of these deaths occurred in the first 2 years of the study and were due to technical errors. One patient died 10 days postoperatively of recurrent esophageal bleeding. At autopsy, a thrombosed portacaval shunt was disclosed at the site where 2 femoral vein grafts had been sewn together. The other patient died 32 days postoperatively after having been home for 2 weeks. He died in hepatic coma with terminal esophageal hemorrhage and at autopsy had a thrombosed splenorenal shunt to half of a bifid renal vein.

Late mortality. In addition to the 2 operative deaths 7 additional patients are known to have died. Two of these patients continued to drink heavily and died of hepatic failure in 37 months and 10 months, respectively. Neither patient had had further gastrointestinal bleeding and at autopsy both shunts, one a side-to-side portacaval (Fig. 4) and the other an end-to-side splenorenal, were widely patent. Two patients died of severe hypertension and cerebral hemorrhage at 5 and 2 years postoperatively without further gastrointestinal bleeding. There was no autopsy in either case. One nonalcoholic patient died with liver failure 2½ years after operation without bleeding, and likewise autopsy was not performed. One patient continued to drink heavily and had 2 minor hematemeses in the first year after operation. He also required cholecystectomy and removal of common duct stones 1 year postoperatively. He was hospitalized again 1 year later for varicose saphenous veins and had no gastrointestinal complaints. He was found dead by police 26 months after operation of a presumed coronary thrombosis. The final patient was a 66 year old man with aortic stenosis and heart block who died in another hospital following a strangulated umbilical hernia 18 months after portacaval shunt. At autopsy the shunt was patent and smooth, and there had been no gastrointestinal bleeding.

Postoperative bleeding. In addition to the operative deaths of 2 patients who bled terminally, 4 other patients are known to have bled postoperatively. One of these who had a portacaval shunt with an H graft vomited approximately a cupful of blood 10 months postoperatively at a time when he was drinking heavily. A second patient also had a portacaval shunt with an H graft who had his first recurrent bleeding 2½ years postoperatively and has bled significantly 3 times in 6 years since operation. He had bled an average of 3 times a year in 2 years before shunting. A third patient with a chronic gastric ulcer bled repeatedly after a splenorenal anastomosis until the performance of a subtotal gastrectomy 17 months later. His portal pressure had dropped from 420 to 230 millimeters of saline, and there has been no further bleeding in over 2 years since gastrectomy. The final patient known to have bled was a young Puerto Rican whose portal hypertension was on the basis of schistosomiasis. He bled again moderately 5 months post-

operatively and on x-ray examination had a return of large esophageal varices. This patient should probably have a portacaval anastomosis but has returned to Puerto Rico. A second shunt has not been performed on the same patient so far in this series.

Effect on liver function. Specific data on postoperative liver functions are not available in over half of the patients in this study. Several who continued to drink heavily had progressive evidence of increasing liver disease with dropping serum albumin and rising bilirubin. There were 5 patients who showed significant improvement in liver function postoperatively. In general, they were patients who had been able to survive repeated hemorrhages for several years before surgery. The benefit no doubt came from preventing further hemorrhage and emphasizing a good diet.

FIG. 4. Side-to-side portacaval shunt looking into portal vein through opened vena cava. Removed at autopsy 3 years postoperatively.

DISCUSSION

The true test of the adequacy of the shunting procedure for portal hypertension is its efficiency in the prevention of recurring hemorrhage from esophageal and gastric varices. In this respect, portacaval anastomoses with the use of an interposed vein graft appeared inferior in the present study. Of the 6 patients so treated, 1 died postoperatively with a thrombosed double graft and 2 others bled; 1 significantly 3 times in the 6 years since operation, and 1 twice to a minor degree before he died of coronary thrombosis 26 months postoperatively. None of the side-to-side or end-to-side portacaval shunts has so far been followed by recurrent bleeding. Of the 15 patients with splenorenal anastomoses, 1 died postoperatively of a thrombosed shunt, 1 bled operatively for 17 months until a subtotal gastrectomy was performed for a gastric ulcer, and in 1 with schistosomiasis, recurrent esophageal varices developed and he has had several minor episodes of bleeding in the year since operation. The mortality for the two types of shunt was approximately the same.

No evidence was found in the present study of postoperative meat intoxication with either type of shunt. There were only 2 Eck fistula end-to-side portacaval shunts, however, and both of these were performed within the past year.

No shunts were performed for ascites alone. Two of the 3 patients who were operated upon for a huge spleen without a history of bleeding had ascites, but in both the ability to reduce it on a low sodium diet was demonstrated. Neither was troubled by ascites postoperatively.

The smallest diameter of vein used for anastomosis in this study was 8 millimeters in the patient with Cruveilhier-Barmgarten syndrome. Portovenograms had shown that the portal vein was also small with a filling defect in it, and it was considered unwise to interrupt the existing collateral circulation.

The shunt has been judged adequate on the basis of disappearance of the bruit and no further hematemesis in over 2 years of follow-up. By Poiseuille's law for computing the rate of flow in small vessels, in the absence of turbulence, flow is directly proportional to the pressure but increases according to the fourth power of the radius of the vessel as vessels increase in size. Thus an 8 millimeter splenic vein is the equivalent of 4,096 collateral vessels with an average diameter of 1 millimeter.

SUMMARY

1. During 8 years, 40 patients were operated upon for portal hypertension. Splenorenal or portacaval shunts were performed in 27 and were considered impossible or contraindicated in the other 13.

2. Acute esophageal bleeding was treated initially with the Sengstaken-Blakemore tube with recurrent bleeding, coma, and death in over half of patients so treated. Selected patients were then treated by transesophageal ligation of varices with cessation of bleeding and no mortality in the 3 patients so treated.

3. Criteria of suitable preparation for shunting included disappearance of jaundice and most if not all of the ascites, a serum albumin level of 3 grams per cent or more, a bromsulphalein retention of not over 25 per cent, a hemoglobin of 10 grams or more, and no significant bleeding for a month preoperatively.

4. Percutaneous splenoportograms and portovenograms were useful in the selection of the most suitable shunt.

5. Portacaval shunts were performed 12 times, side-to-side in 4, end-to-side in 2, and with the interposition of a segment of superficial femoral vein in 6. Splenorenal shunts end-to-side were performed 15 times.

6. There were 2 operative deaths for an operative mortality of 7.4 per cent. Seven additional patients died in from 10 to 60 months, none of recurrent bleeding. All but the last 3 patients operated upon were followed-up for between 1 and 6 years.

7. Of the 4 patients who bled postoperatively, 2 had vein grafts, 1 had a splenorenal shunt for schistosomiasis, and 1 bled following splenorenal anastomosis until the resection of a benign gastric ulcer.

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RESULTS OF OSTEOTOMY OF THE SPINE ACCORDING TO THE TYPE OF CURVATURE

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In 1945, SMITH-PETERSEN described an operative procedure which he termed "osteotomy of the spine." The operation was confined to the laminae and articular facets and did not involve the vertebral bodies. The purpose of this technique was to correct the common deformities of the spine in rheumatoid arthritis; namely, forward bowing of the spine in Marie-Strümpell's disease. Ankylosis of the spine with a more or less pronounced forward bowing is the usual final deformity in this condition and the kyphosis extends from the lumbar region to the occiput. The arch of the spine, however, may involve mainly the dorsal spine taking the shape of a question mark (Fig. 1). On other occasions, the entire dorsocervical spine forms a bow and sometimes, the involvement is confined to the lumbodorsal region or the whole lumbodorsocervical column taking the shape of a parenthesis (Fig. 2). When the rigid curvature of the spine is formed at the dorsal segment, osteotomy at the lumbar region gives a fair amount of relief, but less, if the cervical spine is also fixed in flexion continuing the dorsal bowing. In this case, the patient remains with a goodly amount of dorsal gibbus or round back, though he is able to see forward and "have a drink standing" (Fig. 3). On the contrary, when the abnormal fixed curvature starts at the lumbar segment, extending up the dorsal segment, the operative result is striking from the functional and cosmetic points of view (Fig. 4). In those cases in which the deformity is limited to the dorsal segment, osteotomy of this region should be the technique of choice. Smith-Petersen, in his original paper, cited a case of thoracic osteotomy with subjective improvement but no objective evidence.

Smith-Petersen advised one or more osteotomies at different successive levels of the lumbar region. His osteotomy consists of opening an oblique gap at the level of each of the small ankylosed vertebral joints. This gap runs from above downward and inward opening the intervertebral notch. The osteotomy was followed by a spinal fusion. The operation is performed with the patient in the prone position. He reported upon his first 6 cases.

In 1946, La Chapelle reported a case of osteotomy of the lumbar spine for the same condition. It was performed in two stages: (1) removal of the lamina of the second lumbar and lower joints, freely opening the intervertebral foramen; (2) about 2 weeks later, a subperiosteal section of the common anterior vertebral ligament at the level of the second lumbar disc, plus its excochleation. At the end of this operative stage, as the patient lay on the right side he was turned into the supine position so that the spine straightened out while the gap closed at the level of the osteotomy. Then, bone chips were packed into the space left between the bodies of second and third lumbar vertebrae. There were no postoperative neurologic complaints. For 3 months, the patient was incased in plaster of paris while in bed and walked with a plaster jacket during that time, after which he wore a light jacket for several months as a precaution.

In 1946, Giddings reported a case of a V shaped osteotomy performed between the fourth and fifth lumbar vertebrae, followed by spinal fusion. The patient was operated upon in the prone position, fitted with a Taylor spinal brace, and was walking 3 weeks after the operation. Later, the patient was fitted with a Baker brace (a three point

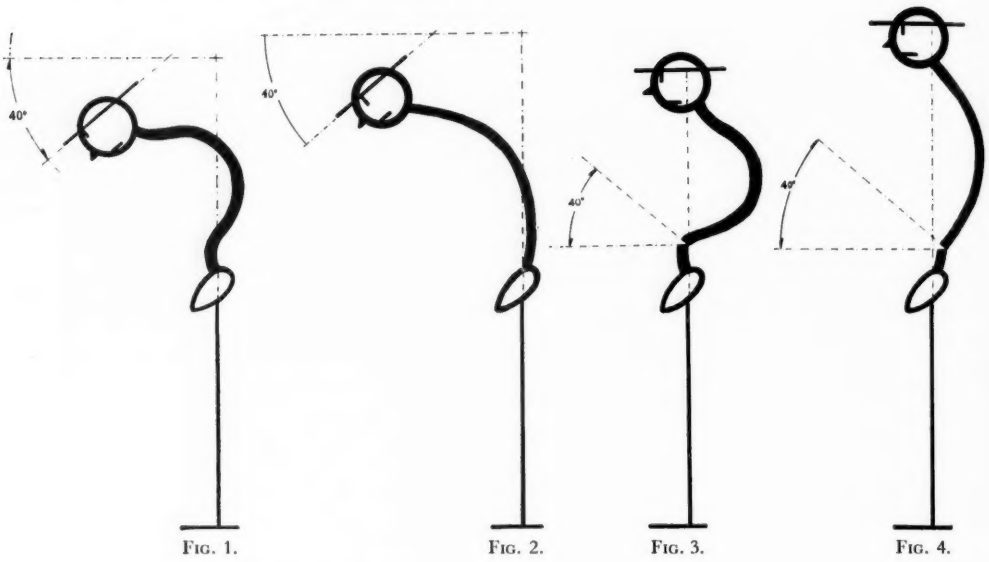

FIG. 1. FIG. 2. FIG. 3. FIG. 4.

FIG. 1. Schematic drawing showing the question mark type curvature with a forward inclination of the trunk of 40 degrees.

FIG. 2. Schematic drawing showing the parenthesis type curvature with a forward inclination of the trunk of 40 degrees.

FIG. 3. First type of curvature after a 40 degree lumbar osteotomy of the spine. The trunk is erect, patient faces forward, but a very noticeable dorsal gibbus remains.

FIG. 4. Second type of curvature after a 40 degree lumbar osteotomy of the spine. The trunk is erect, patient gains a great deal in stature; striking cosmetic result.

supporting brace) and was able to "gargle his throat" for the first time in many years.

In 1948, Herbert reported 4 cases. Of these, in 2 a two stage osteotomy was required and in 2, correction was obtained at the first stage. Herbert performed the posterior osteotomy by removing a trapezoid wedge with the apex at the level of the intervertebral foramen between the second and third lumbar vertebrae and the base formed by the two corresponding spinous processes. The patient was in the prone position. If necessary, the second stage was performed later in a manner similar to the procedure described by La Chapelle. Plaster of paris was applied and the patient walked after 2 or 3 weeks.

Herbert stated that, following operation, there might be fairly acute pain in the region of the lower portion of the abdominal wall and the upper portion and lateral aspect of the thigh in the distribution of the lateral femoral cutaneous nerve. The pain lasted about 10 days and was relieved by flexing the hips to release tension on the nerves.

Again in 1955, Herbert reported 42 cases of osteotomy of the spine performed by his own technique. In this report he included the previously reported 4 cases. Of the 42 osteotomies, 40 were performed for correction of Marie-Strümpell deformity of the spine; 1 for congenital kyphosis, and 1 for traumatic kyphosis. In 22 cases the osteotomy was done on the lumbar spine; in 9 on the dorsolumbar spine (between the twelfth dorsal and first lumbar vertebrae); in 7 on the lower dorsal spine; and in 3 on the cervical spine. In 10 cases the posterior osteotomy was supplemented by an anterior procedure. The cosmetic result was marked improvement in all the cases, and in the majority it was a complete success. In 7

FIG. 5.

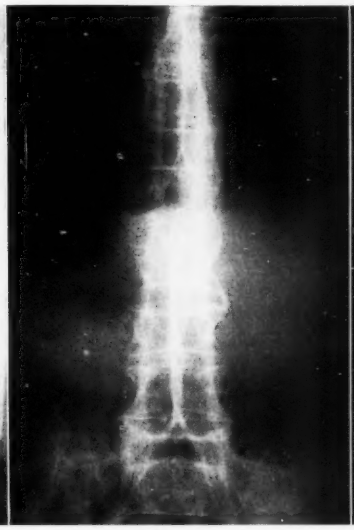

FIG. 6.

FIG. 7.

FIG. 5. Case 1. Patient faces down while standing, but lumbar and cervical lordosis remain near normal. Deformity is a dorsal gibbus or question mark type curvature.

FIG. 6. Case 1. Anteroposterior view of dorsolumbar spine showing the typical aspect of bamboo spine.

FIG. 7. Lateral view of the same patient showing compact mass of bone formed by laminae and small joints. Vertebral common anterior ligament is not calcified at the level of the interspace between the second and third lumbar vertebrae. Lumbar lordosis nearly normal.

cases, bone grafting was necessary at once or later because of nonunion. In 3 cases, the deformity recurred from lack of proper support. Herbert recommended a plaster of paris jacket for 4 months followed by a spine brace. He also stated that if the correction of the angulation brought the line of force back to the normal, the danger of secondary deformity was slight. Regarding complications, the most formidable was cord compression which occurred in 3 instances: in 2 during transportation to the x-ray department from insufficient support, and in a third case, a cervical osteotomy, the result was fatal. In general, his patients were out of bed the third week.

In 1949, Law showed a film of the operation and the dramatic results of osteotomy of the spine for Marie-Strümpell disease. On producing a compensatory lumbar lordosis by making a gap in the neural arch and angulating the spine at this level by osteoclasis, the cosmetic correction was achieved. Not only was bone removed from the laminae and articular processes but the margins were so shaped that the fragments interlocked safely when the spine was extended. Plaster of paris was applied to the trunk and thigh. Law presented 17 cases of successful operations.

Again in 1952, Law mentioned the fact that osteotomy of the spine should not be left until the deformity is extreme. In earlier stages an easy correction can be made under a one stage operation; whereas, if the deformity is extreme, correction must be carried out in two or more stages because of contracture of the soft tissues and the risk of damaging important structures, such as the aorta, the inferior vena cava, and the nerve trunks to the lower extremity. Law stated that he had not undertaken spinal osteotomy in the cervical spine because of the relative narrowness of the spinal canal and the danger of injury to the spinal cord; in the thoracic region, involvement of the costo-

FIG. 8. Lateral view of the dorsal spine showing the pronounced curvature of this segment.

vertebral joints would make correction difficult, if not impossible. He had never found it necessary to divide the anterior longitudinal ligament through an anterior approach. His series consisted of more than 30 cases with 4 deaths.

In 1952, Adams established the technique, dangers, and safeguards of this operation.

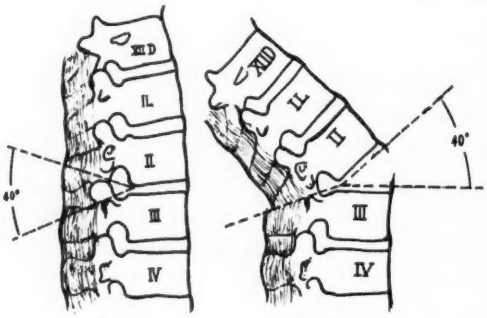

FIG. 9. FIG. 10.

FIG. 9. Schematic drawing showing the cuneiform mass of bone to be removed, opening up the spinal canal and adjacent foramina.

FIG. 10. Closing of the posterior gap and opening of the intervertebral space in front (same angle as the angle left by the bone removed in back).

Although the operation presented little technical difficulty, there were serious potential dangers during the operation and early postoperative periods, demanding particular care. Adams undertook the operation with the patient in the lateral position, preferably on the left side. A wedge of bone was excised from the posterior elements of the spinal column, after which the spine was forcibly hyperextended at the level of the osteotomy by three points of pressure: sternum and symphysis pubis in front and osteotomy site behind. The wedge was usually removed at the level of the second to third or third to fourth lumbar interspace, wherever the principal deformity existed. The base of the wedge was posterior and the apex at the posterior rim of the selected intervertebral disc. A postoperative posterior plaster shell was applied for 10 weeks, and a full length plaster jacket to allow the patient up. Three or 4 months later this was changed for a spinal brace. Adams pointed out the dangers and safeguards: Anesthetic difficulties may occur, viz., if the head is in great flexion the respiration may be difficult; the lateral position diminishes this possibility. Injuries to the cauda equina may occur either from stretching or from displacement of one spinal segment on the other. Stretching will not occur if the apex of the wedge removed falls in front of the spinal canal. Stability of both segments of bone is gained when, on closing the wedge, there is bone to bone contact.

Rupture of the aorta and vena cava is a distinct danger if correction through a large angle is attempted and especially if the aorta is the seat of degenerative changes.

Fracture of an ankylosed cervical spine in a patient with severe flexion deformity may occur if the patient is operated upon in the prone position and the head takes part of the body weight or if the extension force is applied to the head. Acute dilatation of the stomach and paralytic ileus constitute the most serious danger in the early postoperative period. Active treatment at the first onset of symptoms is clear: gastric suction,

FIG. 11.

FIG. 12.

FIG. 13.

FIG. 11. Case 1. After lumbar osteotomy. Very good functional result. Patient faces forward. Poor cosmetic result: the trunk keeps the very noticeable dorsal gibbus or "round back."

FIG. 12. Case 1. Postoperative anteroposterior view shows the osteotomy site with bony union.

FIG. 13. Case 1. Postoperative roentgenogram showing the opening of the intervertebral space in front of the site of the osteotomy. Bony union has taken place.

intravenous fluids, and turning of the patient to the prone position. Pressure sores develop very easily in these patients if they are not turned with some frequency.

In 1956, Lichtblau and Wilson stated that the danger of rupture of the aorta was not theoretic but real, and advised a two stage operative procedure. They reported a case of rupture of the aorta following maneuvers under general anesthesia to straighten out the kyphos. On doing this, the aorta, which was adherent to the adjacent anterior longitudinal ligament, tore off in a transverse manner exactly opposite the gap produced between the first and second lumbar vertebrae. This patient had received previous x-ray therapy (2,000 r.) over the thoracolumbar spine. Of their 5 cases reported, one patient had received a low dosage of preoperative radiation therapy 1 week prior to operation and another had received 2 courses of x-ray therapy 4 years prior to surgery with a total dosage of only 600 roentgens. In none of them was there any postoperative complication. The osteotomies were performed at two or three levels in a one stage procedure, but the correction was gained at the expense of only one interspace opening up anteriorly. Anyway, these investigators believe that large doses of x-ray therapy might be a factor in producing fibrous fixation between the aorta and the underlying anterior longitudinal ligament.

In 1956, Pais reviewed 228 cases of Marie-Strümpell disease in 62 of which surgery had been performed upon hips, knees, parathyroid glands, and spine. Six vertebral osteotomies were done, mainly for extreme kyphosis: 5 of them in the lumbar region and 1 in the dorsal. His results were

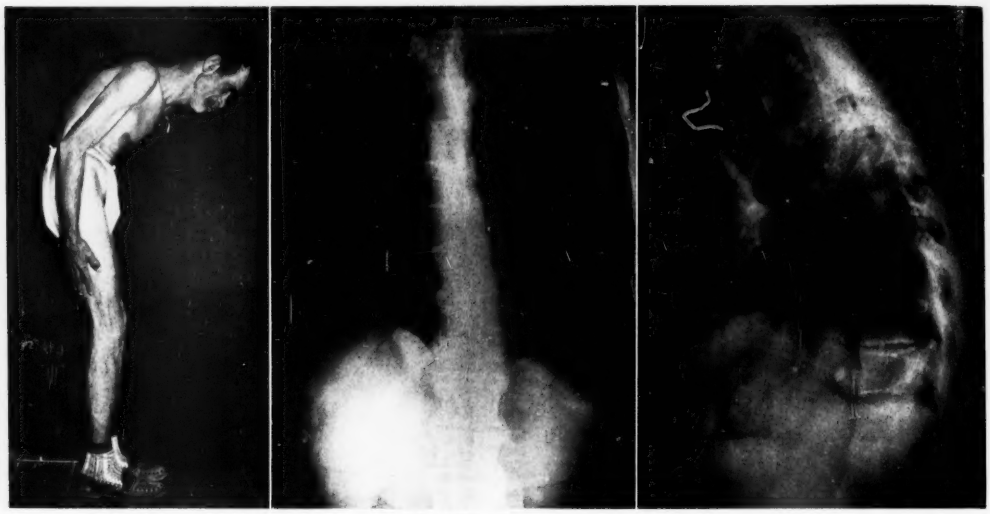

FIG. 14. FIG. 15. FIG. 16.

FIG. 14. Case 2. Patient faces down while standing. This very long parenthesis type curvature involves the entire spine.

FIG. 15. Case 2. Anteroposterior view of dorsolumbar spine with the typical bamboo picture of advanced Marie-Strümpell disease.

FIG. 16. Case 2. Lateral view of the dorsolumbar spine showing a continuous long forward bowing of the entire column. Common anterior ligament ossified from the space between second and third lumbar vertebrae down.

favorable. He stated that this technique should become a routine procedure.

CASE REPORTS

Following are 2 typical cases of osteotomy of the spine: one of the question mark type of deformity involving the dorsal spine, and the other, the parenthesis type of deformity involving the lumbodorsal column.

CASE 1. F. M., 51 years old, 7 years prior to admission on March 8, 1954 started complaining of pain in the low back and slow forward bending and stiffness of the spine. Pain spread all over the spine and the deformity acquired the present shape. On examination, the whole spine was found to be fixed. The patient walked or sat in a chair facing down to the floor. He could not drink from a cup or bottle or gargle his throat. The neck was almost fixed, with less than normal lordosis. The lordosis of the lumbar spine was near normal. The curvature of the dorsal column was increased giving rise to the deformity (Fig. 5). There were two large transverse creases in the abdomen from the forward bending of the trunk. The patient walked with hips and knees in moderate semiflexion to be able to look forward as much as possible. There was no involvement of other joints. Results of laboratory examinations were negative, including sedimentation rate.

Roentgenograms of the dorsolumbar spine in the anteroposterior view (Fig. 6) showed the typical aspect of a bamboo spine. The lateral view of the lumbosacral spine (Fig. 7) showed a compact mass of bone formed by laminae and articular processes without joints left between these processes. The vertebral common anterior ligament was not calcified at the level of the interspace between the second and third lumbar vertebrae. The lumbar spine maintained most of its normal lordosis. The forward bowing of the spine started in the proximal lumbar spine. The lateral view of the dorsal spine (Fig. 8) showed the same posterior bony mass plus marginal osteophytes in the vertebral bodies and a calcified common anterior ligament. The curvature of the dorsal spine was such, that while cranial and caudal surfaces of the bodies of the lower dorsal vertebrae faced cephalad and caudad, the same surfaces of the upper dorsal vertebral bodies faced exactly forward and backward respectively, constituting a rotation of 90 degrees. The decision was made that if osteotomy of the spine were feasible at the dorsal level, the maximum cosmetic and functional result would be obtained by operating upon the dorsal spine at the middle of the dorsal arch.

FIG. 17.

FIG. 18.

FIG. 19.

FIG. 17. Case 2. Lateral view after high lumbar osteotomy showing the opening of the space between first and second lumbar vertebrae.

FIG. 18. Case 2. Anteroposterior view showing the site of the osteotomy.

FIG. 19. Case 2. Striking cosmetic and functional result in this parenthesis type of curvature after high lumbar osteotomy. Patient wearing hyperextension brace of the Jewett type.

On June 10, 1954, under general anesthesia, a blood transfusion was given, and with the patient lying on his left side, the posterior aspect of the spinal column was exposed through a midposterior incision. A continuous bony mass was found in which the spinal processes and small joints could not be identified. A cuneiform section of this mass was removed, with the base backward and the apex in front of the spinal canal. The bone removed comprised the spinous process of the second lumbar and part of the third lumbar plus laminae and corresponding joints between the second and third lumbar vertebrae, opening freely and fully both intervertebral foramina. The gap left was a dihedral angle of about 40 degrees (Fig. 9). The patient was turned facing downward with the head out of the table to avoid any leverage force in the cervical spine. With mild pressure the spine "broke" straightening out the trunk and closing the gap surgically made (Fig. 10). The wound was closed in layers. The patient was left lying flat in bed but was turned as soon as possible. At the end of 6 weeks he sat up and started walking after being fitted with a hyperextension brace of the Jewett type.

He complained of radiating pain down both thighs that lasted for several months. The patient was able to look forward and "take a beer" or drink anything standing or sitting.

In this case, the deformity was mainly dorsal or of the question mark type, so that the cosmetic correction was not as striking as desired. The dorsal gibbus remained unchanged (Fig. 11). Postoperative roentgenograms show the osteotomy site at the level of the interspace between the second and third lumbar vertebrae with an opening of the intervertebral space of about 40 degrees (Figs. 12 and 13).

CASE 2. A. M., 50 years old, was admitted on February 27, 1954. He had complained of pain in the lumbosacral region since 1928. This condition had worsened since 1941. About 7 years previously a slow steady forward bowing of the trunk started. The patient walked facing down, unable to see forward or drink liquids from a cup, glass, or bottle while sitting or standing. There was limitation of the neck motion of about half of the normal range. The dorsolumbosacral spine was absolutely stiff. Shoulder motion was

slightly limited on the right and less on the left. Motion of both hips was slightly limited, extension being possible to 170 degrees. Results of laboratory examinations, including sedimentation rate, were within normal limits.

Figure 14 demonstrates that the forward bowing of the trunk started all the way down from the sacrum up to the lower cervical spine. There was no dorsal gibbus but a continuous long curvature of the whole spine like a parenthesis. In this case, correction should show a striking cosmetic result. The gap to be opened between the chosen vertebral bodies may be an angle of much less aperture to attain a pretty good cosmetic result.

Anteroposterior roentgenograms of the dorsal and lumbar spine showed the typical bamboo picture of advanced Marie-Strümpell disease (Fig. 15). Lateral views of the spine (Fig. 16) showed a continuous forward bowing of the dorsolumbar spine. The lumbar lordosis had disappeared. The anterior common vertebral ligament was ossified from second to third lumbar intervertebral space down. In the dorsal spine some of the discs were calcified. The whole aspect of the deformity of the spine was quite different from the previous case, demonstrating a continuous arch of very large radius extending from sacrum to low cervical column.

On January 14, 1954, under general anesthesia, a blood transfusion was given, and with the patient lying on his left side, the lumbar spine was exposed through an incision of about 30 centimeters. A bony mass was found replacing small joints and laminae. Spinous processes were not involved in that mass. Two gaps were opened in the form of a dihedral angle, each of about 30 degrees, with the apex just in front of the medullary canal, one between the first and second lumbar and the second between the third and fourth lumbar vertebrae. The foramina were opened at both levels. The patient lay prone with face and neck out from the table. Under an audible snap the spine was slowly straightened until the patient lay flat on his chest and pelvis. The gap between the first and second vertebrae closed, the lower one remaining unchanged. The lower gap was covered with a bone roof and bone chips. The wound was sutured in layers. The patient was left flat in bed without any support. Turning of the patient was started as soon as possible.

He complained of pain in the distribution of the lateral cutaneous nerves of the thighs for several weeks. At the end of 2 weeks the patient was fitted with a hyperextension brace of the Jewett type allowing him to sit up and get out of bed several days later.

Postoperative roentgenograms (Figs. 17 and 18) showed, in the lateral view, an opening of about 30 degrees at the level of the interspace between the first and second lumbar vertebrae. The gap opened at the level of the space where the anterior ligament was not calcified. A posterior gap at the level of the interspace between the third and fourth vertebrae was roofed with bone chips. The cosmetic correction in this case was striking especially if compared with the previous case (Fig. 19).

SUMMARY

1. The pertinent literature has been reviewed and a revised technique presented of osteotomy of the spine for forward bowing of the vertebral column in Marie-Strümpell disease.

2. The dangers and safeguards in this operation are stressed.

3. Two types of curvature are described demonstrating the different results in each one: the deformity in the shape of a question mark and deformity in the shape of a parenthesis.

4. Two illustrative cases have been presented.

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SARCOMA OF THE MAMMARY GLAND

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PRIMARY SARCOMA of the mammary gland has long been recognized as an infrequently occurring but a distinct entity. The present study of the clinical and microscopic features of sarcoma of the breast was undertaken in an attempt to bring some clarification to such factors as the history and physical findings, gross and microscopic pathologic observations, clinical course, and appropriate therapy associated with this type of primary neoplasm of the breast.

MATERIALS AND METHODS

The records of all patients seen at the Mayo Clinic during the 50 years between 1907 and 1956, inclusive, whose diagnoses contained the term sarcoma in reference to a tumor of the breast were selected for study. The histories and the operative and pathologic reports were reviewed and abstracted. The gross and microscopic pathologic features of the available operative specimens were studied and evaluated. The presence of a benign epithelial component in a neoplasm, the stroma of which was richly cellular, indicated to us that the fundamental lesion was a fibroadenoma. Because the clinical course of fibroadenomas is benign, these lesions have been excluded from this study, but will be reported in another article.

There were 34 cases in which the microscopic features of the primary lesion were consistent with a diagnosis of true primary sarcoma of the breast. In 2 of the 34 cases there was no operative specimen available because of extensive recurrent or metastatic disease, or both, at the time of initial examination. The diagnosis of sarcoma of the breast in reference to each of these lesions was based on review of sections of the primary tumor made available by the patient's home physician.

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Abridgment of portion of thesis submitted by Dr. Botham to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery.

CLINICAL FINDINGS

The mean age of the 34 patients was 49.2 years, the extremes being 21 and 69 years. There were 33 women and 1 man in the series. The incidence according to side of the body was equal, 17 instances of the lesion having been noted on each side. The mean duration of the lesion, as recorded in 28 cases, was 55.05 months. A period of rapid growth, averaging 4.25 months, had been noted in 18 cases. Antecedent trauma was a complaint in only 1 instance. Loss of weight just prior to the initial examination was noted in 6 patients, only 1 of whom had evidence of metastatic disease at the time of the complaint. Pain in the involved breast had occurred in 14 of the 34 cases, but the detailed character of the pain had not been recorded.

Retraction of the nipple had occurred in 2 instances, in 1 of which this complication was bilateral. Fixation of the skin overlying the tumor mass was recorded in 10 instances. Change in color of the overlying skin had occurred in 7 cases. Ulceration of the overlying skin had occurred in 3 patients. Palpable ipsilateral involvement of the axillary lymphatic vessels had been demonstrated in 10 of the 34 cases.

The interpretation of the roentgenogram of the thorax made at the time of initial examination was available in 32 cases. In 31 cases, the roentgenograms had been interpreted as disclosing nothing abnormal, while in the remaining case the roentgenogram

showed evidence of extensive metastatic disease.

Primary surgical therapy had consisted of local excision (7 cases), simple mastectomy (3 cases), simple mastectomy plus roentgen therapy (1 case), simple mastectomy plus pectoral-muscle excision (2 cases), radical mastectomy (10 cases), radical mastectomy plus roentgen therapy (10 cases), and radical mastectomy plus the use of Coley's toxins (1 case).

Thirteen of the 34 patients ultimately had recurrent disease occurring either in the breast or on the anterior thoracic wall. Primary therapy in these 13 cases had consisted of local excision (7 cases), radical mastectomy plus roentgen therapy (3 cases), radical mastectomy plus the use of Coley's toxins (1 case), simple mastectomy (1 case), and simple mastectomy plus pectoral-muscle excision (1 case).

Evidence of metastatic disease was based entirely on roentgenograms, since no postmortem or surgical metastatic tissue was available for study. There were 9 cases in which roentgenographic evidence of metastasis was demonstrated. In each of these 9 cases, pulmonary metastasis was demonstrated in the contralateral lung, in the lungs bilaterally, or as a discrete lesion in the ipsilateral lung. In addition, roentgenographic evidence of metastatic disease had been noted in the pelvis, sternum, mediastinum, and cervical and lumbar vertebrae. In each of the 6 groups of primary sarcomas of the breast to be discussed subsequently, 1 or more instances of metastatic disease had occurred.

Tissue from all cases in which ulceration had developed and in which the tumor process had approached the overlying skin was studied for microscopic evidence of involvement of the integument by the tumor. No microscopic evidence of involvement of the skin was detected.

There were 19 cases in which primary radical mastectomy had been done and in which the surgical specimen was available for study. In 2 of these cases there was microscopic evidence of invasion of the underlying pectoral musculature. In no case was there any demonstrable microscopic evidence of metastasis to axillary lymph nodes.

Broders' system of grading, which employs the fundamental principle of cellular differentiation, was applied to these lesions. Only 5 lesions were considered to be of grade 1, while the remaining 29 lesions were graded either 2, 3, or 4. None of the grade 1 lesions had metastasized, whereas 8 of the 9 lesions in cases in which there was roentgenologic evidence of metastasis were graded 3 or 4. There was no apparent correlation between the grade of the lesion and the likelihood of its recurrence.

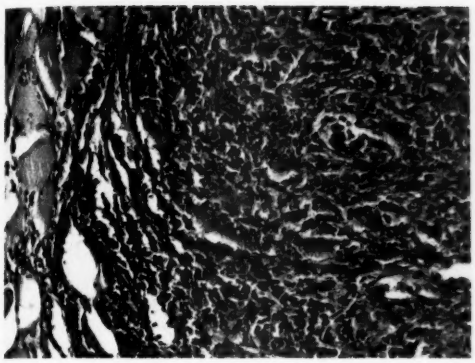
PATHOLOGIC FEATURES

In general, the gross lesions were circumscribed, partially or wholly encapsulated, and irregular or lobed on the exterior surfaces. The size of the lesions varied, the extremes being 1.5 and 15 centimeters in diameter. The tumors generally were firm. The cut surface bulged, was smooth and glistening, either homogenous or whorled in appearance, and contained occasional areas of necrosis. Fixation in formalin had altered the natural colors of the tumors which were, therefore, not recorded.

Six groups of primary sarcomas of the breast were found in the 34 cases in this series. These groups were based on cell type and were classified as follows: fibrosarcoma (14 cases), rhabdomyosarcoma (4 cases), osteogenic sarcoma (5 cases), liposarcoma (1 case), malignant mixed tumor of breast (5 cases), and mixed fibrosarcoma and carcinoma (5 cases).

The sample blocks of tissue from which the microscopic sections were cut were stained with hematoxylin and eosin.

The fibrosarcomas (Fig. 1a and b) were composed primarily of fusiform or spindle-shaped fibroblasts. The cytoplasm of these cells was acidophilic, rather scanty, and extended from both ends of the cells. The nuclei also were spindle-shaped, occasionally



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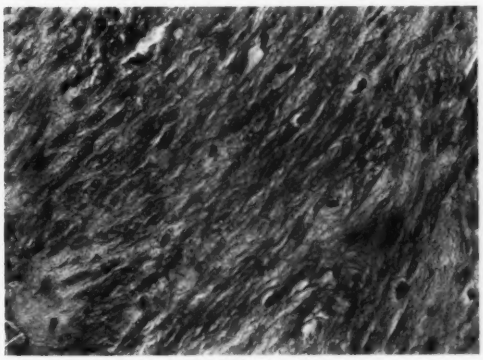

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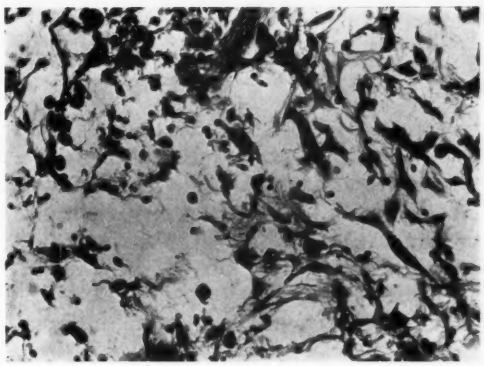


c

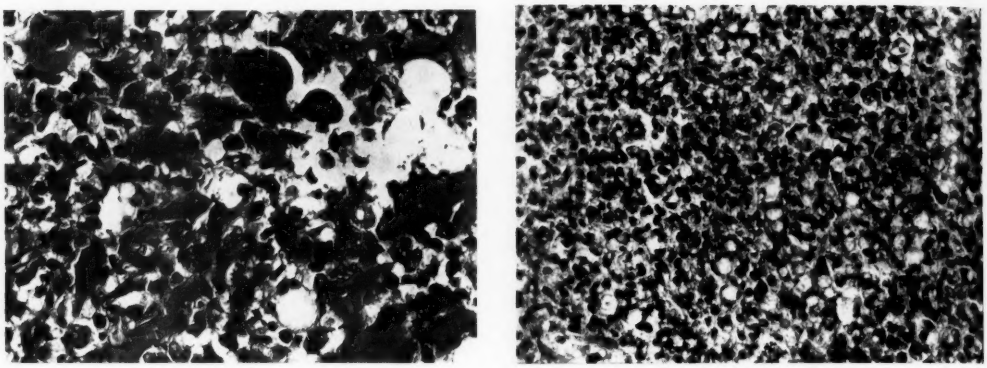
FIG. 1. a, Fibrosarcoma (hematoxylin and eosin, ×147). Lesion is invading underlying pectoral muscle, as seen on left. Patient with this lesion ultimately died of metastatic disease. b, Fibrosarcoma (hematoxylin and eosin, ×295). Abnormal mitotic figures evident at 5, 7, and 10 o'clock. c, Rhabdomyosarcoma (hematoxylin and eosin, ×147). Racquet cell at 11 o'clock. Numerous strap cells throughout the section.

lobular and contained 1 or more dark-staining nucleoli. As the cellular differentiation diminished, the size and shape of the fibroblasts were more varied. Small vessels were detectable and were most common at the periphery of the anaplastic lesions. Abnormal mitosis was detectable in all lesions, varying in frequency with the degree of cellular differentiation. Varying quantities of myxomatous tissue were noted in which the cells had little cytoplasm and the cell nuclei were primarily stellate in shape. Tumor giant cells containing as many as 30 to 40 nuclei were seen in the more anaplastic lesions.

All the rhabdomyosarcomas (Fig. 1c) were anaplastic, high-grade lesions. The presence of many bizarre forms of tumor giant cells suggested initially that these lesions were not fibrosarcomas. In each case racquet cells, with the nucleus at one expanded end of a teardrop-shaped cell, were demonstrable. Strap cells with longitudinal myofibrils and often with 2 or more nuclei also were seen in each lesion. Special staining techniques for the demonstration of cross-striations were unrewarding. The presence of bizarre giant cells, racquet cells, and strap cells, however, was sufficient evidence on which to base the diagnosis of rhabdomyosarcoma.

All the osteogenic sarcomas (Fig. 2a) contained multiple areas of pink-staining, homogeneous osteoid tissue with trabeculae. Numerous multinucleated tumor giant cells were noted in and about the osteoid trabeculae. Two of these lesions also contained areas of malignant-appearing cartilage.

The only liposarcoma (Fig. 2b) was composed predominantly of lipoblasts of varying sizes. Special stains were employed to confirm the presence of fat within these cells. Mitotic figures were abundant throughout



a b

FIG. 2. a, Osteogenic sarcoma (hematoxylin and eosin, ×147). Areas of osteoid tissue with trabeculae are apparent. Tumor giant cell at 12 o'clock. b, Liposarcoma (hematoxylin and eosin, ×147). Numerous fat-containing lipoblasts are evident.

this high-grade lesion. Occasional tumor giant cells and rather fusiform cells with pyknotic nuclei were interspersed among the lipoblasts.

The malignant mixed tumors (Fig. 3a and b) displayed a rather startling and unusual microscopic picture. Each of these lesions exhibited varying types of malignant mesodermal tissue, such as cartilage, osteoid, bone and fibrosarcoma, intimately admixed with carcinoma. Four of the lesions contained adenocarcinoma while the fifth lesion contained areas of squamous-cell carcinoma with formation of "pearly bodies." Because of the mixture of malignant mesodermal and epithelial tissues, it seemed appropriate to call these lesions "malignant mixed tumors of the breast."

There was also a group of lesions containing fibrosarcoma and carcinoma intimately admixed in a single tumor process (Fig. 4a and b). Unlike the situation in the malignant mixed tumors, fibrosarcoma was the only demonstrable malignant mesodermal tissue in these lesions, and it did not differ significantly from that seen in the group of pure fibrosarcomas.

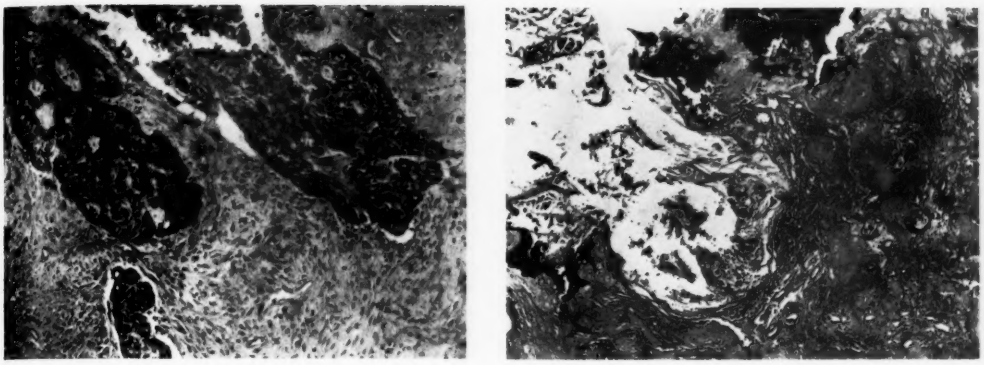
Peripheral encapsulation, which so frequently appeared grossly as a distinct feature, usually was found to be composed primarily of cells which constituted the primary tumor. These appeared to be concentrically arranged cells which were compressed and flattened. In many of the more anaplastic lesions such areas of pseudoencapsulation were infrequently demonstrable, invasion of the contiguous mammary tissue or musculature being the more common finding.

COMMENT

A major problem in the literature on sarcoma of the breast has been to define what is, or is not, a true primary sarcoma of the breast. Many authors have included in their classification of primary sarcoma of the breast those lesions which contain an epithelial component intermixed with richly cellular stroma. These lesions have been called "adenosarcoma," "adenofibrosarcoma," and "cystosarcoma phyllodes."

Harrington and one of us (8) emphasized that the term cystosarcoma phyllodes has been misused to include a whole group of tumors, the great majority of which are benign fibroadenomas. They believe that a small group of undetected fibrosarcomas has been overlooked, and that they are responsible for the malignant connotation applied to a group of benign neoplasms.

Deaver, Lee, Geschickter, and associates have believed that since such lesions are not really sarcomas, the term cystosarcoma is



a b

FIG. 3. a, Malignant mixed tumor of the breast (hematoxylin and eosin, ×92). Adenocarcinoma and fibrosarcoma readily apparent. Area of osteoid tissue in right upper corner. b, Malignant mixed tumor of the breast (hematoxylin and eosin, ×55). Areas of dark-stained bone and lighter-stained osteoid tissue, cartilage, and adenocarcinoma are apparent. Lesion ultimately metastasized.

being unjustifiably employed. They also noted a marked difference in the clinical course of true mammary sarcoma and cystosarcoma, the latter exhibiting an essentially benign course, in contrast to the metastasis sometimes associated with the former.

A group of 22 fibroadenomas with sarcoma-like stroma was studied by us, and the results confirmed our original impression that such lesions do not warrant inclusion as mammary sarcomas.

The average age of 47 to 49 years among patients with sarcoma of the breast, as reported by Lee, Hill, Fox and associates, does not differ significantly from that found in this series of cases.

Mammary sarcoma occurs extremely rarely among men, but Connell has shown that the occurrence of the lesion in men previously has been well documented.

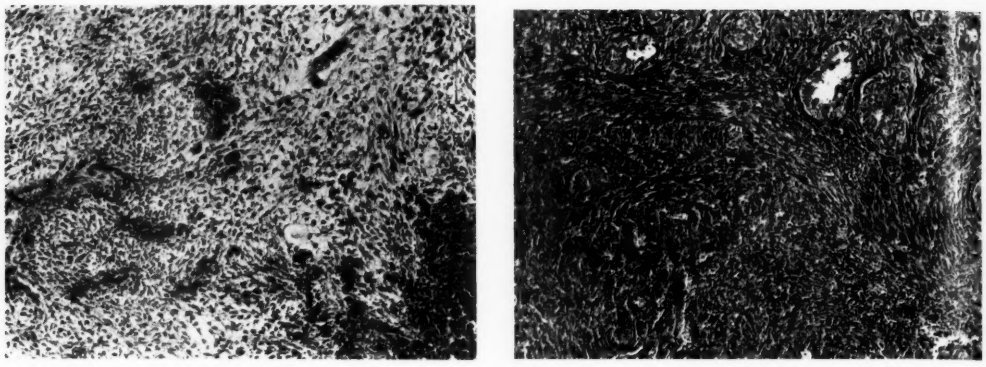
A period of latency or long duration prior to a period of rapid growth are two characteristics frequently associated with sarcoma of the breast. The duration of either or both of these characteristics obviously will vary according to many factors.

Pain in the involved breast in more than a third of the cases confirmed the impression of others that such a complaint deserves more than passing consideration by the clinician.

Fixation of the overlying skin in itself was of little significance. The nature of the fixation was of some concern; in the majority of cases it was described as being stretched or lacking mobility because of pressure and tension. The edema, orange-peel appearance, and retraction of the skin so frequently associated with carcinoma of the breast were lacking. Although actual involvement of the integument by the tumor process was not demonstrated in any of the cases in this series, it has been reported by Gross.

The association of palpable involvement of axillary lymphatic vessels by primary sarcoma of the breast is of little significance, since these tumors rarely, if ever, metastasize to regional lymph nodes. Smithy reported 32 cases in which mixed malignant processes of the breast were found to contain carcinoma as well as sarcoma. In his series, compiled from the literature, 11 instances were found in which axillary nodal metastasis by the carcinomatous element had been demonstrated. This observation obviously becomes significant in determining a course of surgical therapy in mixed lesions containing carcinoma.

The lack of proof of metastatic disease based on study of tissue was somewhat disconcerting. Roentgenographic evidence of



a b

FIG. 4. a, Mixed fibrosarcoma and carcinoma (hematoxylin and eosin, ×74). Area of carcinoma in right lower corner. Attempt at acinar formation by carcinoma cells at 12 o'clock. Malignant myxomatous sarcoma cells predominant in this section of tumor. b, Mixed fibrosarcoma and carcinoma (hematoxylin and eosin, ×74). Attempts at acinar formation by carcinoma cells in upper half of photomicrograph.

metastasis, as interpreted by competent roentgenologists, in the face of an antecedent malignant neoplasm of the breast, seemed sufficient evidence on which to base an impression of metastasis from the lesion of the breast. The possibility that the metastatic disease could have arisen from another primary malignant process cannot be denied, but it seems most unlikely. Proof of metastasis based on study of tissue also would have enabled us to determine the metastasizing element in the malignant mixed tumors and the mixed fibrosarcomas and carcinomas. Lack of axillary nodal metastasis in this series corroborated the impression that sarcoma of the breast metastasizes primarily by way of the blood stream.

The problem of appropriate initial surgical therapy deserves some comment. It is evident that sarcoma of the breast rarely, if ever, metastasizes to regional lymph nodes. It is also apparent that the most common site of recurrence is the breast or anterior thoracic wall. It would seem, then, that an adequate initial surgical procedure should consist of simple mastectomy plus excision of the underlying pectoral muscles. Additive axillary dissection may not increase the operative mortality rates associated with mastectomy, but may well increase the associated morbidity rates. In view of the evidence in the literature of a significant incidence of axillary nodal metastasis in these lesions with a carcinomatous element, it is believed that the presence of such tissue on fresh-frozen section is an indication for radical mastectomy.

In general, the management of recurrent lesions of this type should be wide local excision, unless the extent of the recurrent tumor or the condition of the patient precludes further attempts at surgical extirpation.

The role of roentgen therapy as an adjunct to operation is difficult to assess. The number of cases in which adequate controls were used is too small to allow valid interpretation of the efficacy of roentgen rays. The opinion of the majority of investigators that sarcoma of the breast is radioresistant lends little support to the use of roentgen rays in the treatment of primary mammary sarcoma.

SUMMARY AND CONCLUSIONS

Thirty-four cases of primary sarcoma of the breast have been presented. The factors of diagnosis, history and physical findings, gross and microscopic pathologic aspects, clinical course, and appropriate treatment

of primary mammary sarcoma have been presented and discussed.

We conclude that true primary sarcoma of the breast is a distinct clinical and pathologic entity, and that this lesion may contain 1 or more types of malignant mesenchymal tissue intimately admixed with malignant epithelial tissue. We further conclude that associated palpable involvement of axillary lymphatic vessels is of little significance in determining the appropriate surgical therapy or ultimate clinical course associated with sarcoma of the breast. We submit that true primary sarcoma of the breast rarely, if ever, metastasizes to regional lymph nodes.

We suggest that primary sarcoma of the breast, although occasionally associated with ulceration, rarely invades the overlying integument, but that it is capable of metastasizing, and often does metastasize, primarily by way of the blood stream, most frequently to the lungs. We believe that simple mastectomy, with excision of the underlying pectoral musculature, is adequate therapy for sarcoma of the breast not containing a malignant epithelial component, and that primary sarcoma of the breast which also contains demonstrable carcinoma in fresh-frozen sections should be treated by radical mastectomy.

We are convinced that wide local excision, when feasible, is indicated in the treatment of recurrent sarcoma of the breast.

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THREE YEARS' EXPERIENCE WITH PERIPHERAL ARTERIAL GRAFTS OF CRIMPED NYLON AND TEFLON

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THE MOST SEVERE TEST of any arterial graft is found in replacement of the small vessels of the extremities. Between October 1954 when the first crimped nylon graft was inserted to replace an arteriovenous fistula of the common femoral artery (2, 3) and January 15, 1958, 50 additional grafts have been used in the arteries of the extremities on our service. Crimped nylon grafts have also been used to bypass or replace the aortic bifurcation, the thoracic and upper abdominal aorta, and the carotid arteries but these will not be included in this report.

RESULTS

Indications for arterial grafts in the extremities have included arteriosclerotic aneurysms, especially of the popliteal artery, arterial injuries, and segmental arteriosclerotic obstruction. In this series of 51 cases, summarized in Table I, replacement grafts were used in 8 arterial injuries, 1 arteriovenous fistula, 3 popliteal aneurysms, and 1 traumatic aneurysm of the axillary artery secondary to long term use of a crutch in a man with one leg. Successful restoration of blood flow was accomplished in each of these 13 cases, and there have been no late failures. The patient in Case 4 died of multiple associated injuries 24 hours after replacement of the iliac artery. All other patients have maintained patent grafts for periods up to 2 years and 10 months. All of these replacement grafts have been of crimped nylon tube of the appropriate size to fit the injured artery.

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There have been 38 grafts used as a bypass around segments of obliterative arteriosclerosis in this 3 year period. Only those grafts with outflow into the superficial femoral, popliteal, or brachial artery have been included in this study. There were 11 failures, 7 early and 4 late in this group of cases. The 7 acute failures were almost all predictable because of poor distal run-off and difficult distal anastomosis in a thickened artery with a tiny lumen. Several of these extremities were more severely ischemic after operation; only 1 required amputation.

In 31 patients of the arteriosclerotic group who were discharged with patent grafts, 4 grafts (12.8 per cent) failed from 4 to 17 months after insertion. Three of these late failures consisted of sudden occlusions; 1 was an anastomotic leak followed by thrombosis while resuturing was being attempted in another city. Four of these shunts have functioned over 2 years, while 17 have remained patent over 1 year.

Graft patency has been determined clinically by palpable pedal or popliteal pulses, or occasionally when the distal vessels were occluded, by a pulse over the graft itself. If any question of an open graft remained, a repeat arteriogram has been carried out. Thirty-one of these bypass grafts were of crimped nylon (braided) and the last 7 were of crimped teflon (knitted).

DISCUSSION

This experience with small vessel grafts has led to a more or less standard technique of insertion. In replacement grafts, the tube used should closely approximate the diam-

eter of the artery. Grafts smaller than ¼ inch (6 mm.) inside diameter will have a high incidence of thrombosis regardless of the type of prosthesis. The thrombus that lines any graft after restoration of blood flow will diminish the lumen of small grafts to a dangerous degree. It is believed that the distal anastomosis in small vessel grafts is the critical point from the standpoint of thrombosis, and every effort should be directed toward making this junction as smooth as possible. In our hands this is best accomplished by slight eversion of the lips of the distal arterial incision up around the graft. This technique can be used in both end-to-end anastomoses or distal end-to-side anastomoses (Fig. 1). The proper length of graft to use is that which allows a comfortable fit without tension. When arterial pressure distends a crimped synthetic tube it will elongate slightly. Care should therefore be taken to avoid undesirable redundancy. Two technical features in performing a femoral bypass deserve emphasis. This operation is usually performed by using 2 incisions in the thigh or leg, pulling the graft through a subfascial tunnel between incisions. The tunnel should be large and loose-fitting around the graft to avoid constricting bands. Dilatation of the tunnel can be accomplished with the index finger or a Mayo external vein stripper. Great care should be taken to thread the tube through the tunnel without a twist which would obstruct the lumen.

In performing a bypass shunt, the distal artery is exposed first and carefully palpated for plaques and areas of softness. The most suitable area is selected and this segment is carefully stripped of adventitia. Exposure of the popliteal artery below the knee is greatly facilitated by a longitudinal incision in the medial calf 1 centimeter behind the tibia. By stripping the gastrocnemius fibers away from the tibia, the popliteal bifurcation can be easily dissected with the patient supine. The proximal patent artery is then dissected before performing the distal anastomosis. In most cases the common femoral artery is the

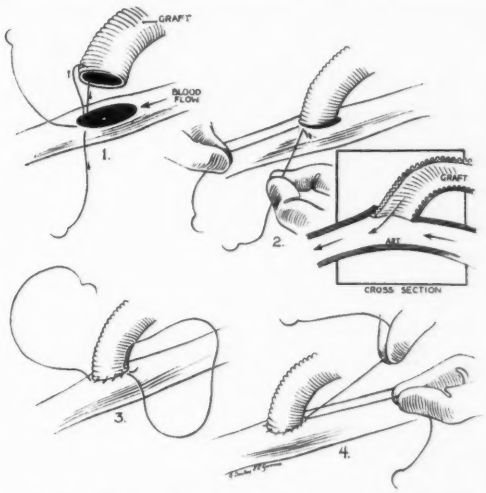

FIG. 1. Technique of distal end-to-side anastomosis. The first stitch is most important in preventing a projecting edge.

site of proximal anastomosis since it has been considered unwise to attach the graft to a superficial femoral artery already involved by progressive arteriosclerosis.

The distal anastomosis is performed first. This step minimizes the time that blood flow to the foot is seriously impeded by clamping the common femoral artery. Graft suture to a thickened narrow popliteal artery is much easier if one end of the tube is unattached. One dangerous error lies in securing only intima in the suture, since an incision in a sclerotic artery allows the muscular wall to retract and the stiff intima to protrude. This procedure is the probable cause of some late anastomotic leaks. If a partial endarterectomy is necessary the intima should be accurately reattached with separate sutures or with the anastomotic suture including all layers.

SELECTION OF GRAFTS

As indicated 43 grafts were of nylon, 7 of teflon, all crimped to avoid kinking. The braided nylon tubes have proved satisfactory but not ideal. The braided construction of the tubes has necessitated heat-sealing of the

TABLE I.—SUMMARY OF 51 CASES OF PERIPHERAL ARTERY GRAFTS (DURATION OF PATENCY IS LISTED AS OF JANUARY 15, 1958)

No.	*Initials*	*Date of insertion*	*Indication for graft*	*Length of graft, cm.*	*Type of graft*	*Inside diameter, in.*	*Result*	*Duration of patency*	*Remarks*
1	B. L.	Oct. 13, 1954	A.V. fistula common femoral	5	Nylon	¼	Success	4 mos.	Died of cardiac failure 4 months after operation
2	McD. L.	Feb. 1954	Pistol wound, superficial fem.	4	Nylon	¼	Success	2 yrs. 10 mos.	Full activity without claudication. Good pedal pulses
3	J. S.	Feb. 1955	Popliteal aneurysm	15	Nylon	5/16	Success	2 yrs. 10 mos.	Had previously lost opposite leg from occlusion of popliteal aneurysm
4	B. J.	Mar. 1955	External iliac, auto injury	22	Nylon	5/16	Success	24 hrs.	Died of associated injuries
5	A. B.	Mar. 1955	Arteriosclerotic superficial fem. obstruction	15	Nylon bypass	5/16	Success	2 yrs. 9 mos.	Back to bricklaying without claudication. Good D.P. pulse
6	J. T.	July 1955	Arteriosclerotic superficial fem. obstruction	39	Nylon bypass	5/16	Acute failure	0	Technical difficulty with bleeding resulted in graft thrombosis
7	F. A.	Aug. 1955	Arteriosclerotic ext. iliac obst.	20	Nylon bypass	3/8	Success	2 yrs. 4 mos.	Ambulatory, fem. pulse present, none below
8	L. L.	May 1955	Pistol wound common femoral	4	Nylon	5/16	Success	2 yrs. 6 mos.	Walks without claudication. Good pedal pulses
9	J. R. K.	May 1955	Pistol wound superficial fem.	7	Nylon	5/16	Success	2 yrs. 6 mos.	Walks without claudication. Good pedal pulses
10	W. D. O.	June 1955	Arteriosclerotic superficial fem. obstruction	37	Nylon bypass	5/16	Late failure	4 mos.	Aneurysm at proximal anastomosis, resected but graft occluded at surgery, amputation
11	J. B.	Jan. 1956	Arteriosclerotic L.-superficial femoral obst.	30	Nylon bypass	5/16	Late failure	1 yr. 5 mos.	Relief of symptoms until graft occluded suddenly while standing on ladder painting
12	J. B.	Apr. 1956	Arteriosclerotic R. superficial femoral obst.	31	Nylon bypass	5/16	Success	1 yr. 8 mos.	No claudication. Good D.P. and P.T. pulse
13	J. P.	Jan. 1956	Arteriosclerotic R. superficial femoral obst.	32	Nylon bypass	5/16	Success	2 yrs.	No claudication, good pedal pulses
14	J. P.	Jan. 1956	Arteriosclerotic L. superficial femoral obst.	30	Nylon bypass	5/16	Success	2 yrs.	No claudication, good pedal pulses
15	C. J. F.	Mar. 1956	Arteriosclerotic superficial fem. obstruction	29	Nylon bypass	5/16	Success	1 yr. 10 mos.	No claudication, good pedal pulse
16	J. S.	May 1956	Arteriosclerotic R. common and superficial fem. obst.	35	Nylon bypass	5/16	Acute failure	0	Two attempts 1 week apart, thrombosis immediately, poor run-off
17	J. S.	May 1956	Arteriosclerotic L. superficial femoral obst.	31	Nylon bypass	5/16	Success	1 yr. 8 mos.	No claudication, good pedal pulse
18	B. S.	June 1956	Arteriosclerotic superficial fem. obstruction	33	Nylon bypass	5/16	Success	1 yr. 7 mos.	Improved but not complete relief of claudication, good popliteal but no pedal pulse
19	B. W.	Jan. 1957	Shotgun wound superficial fem.	10	Nylon replacement	5/16	Success	1 yr.	Walks without claudication. Good pedal pulse. Healed graft in infected wound

TABLE I.—SUMMARY OF 51 CASES OF PERIPHERAL ARTERY GRAFTS (DURATION OF PATENCY IS LISTED AS OF JANUARY 15, 1958)—Continued

No.	*Initials*	*Date of insertion*	*Indication for graft*	*Length of graft, cm.*	*Type of graft*	*Inside diameter, in.*	*Result*	*Duration of patency*	*Remarks*
20	T. D.	May 1956	Arteriosclerotic superficial fem. obstruction	25	Nylon bypass	5/16	Success	1 yr. 7 mos.	No claudication, good posterior tibial pulse
21	M. M.	Sept. 1956	Arteriosclerotic superficial fem. obstruction	30	Nylon bypass	5/16	Success	1 yr. 3 mos.	No claudication, good pedal pulse
22	J. L.	Oct. 1956	Arteriosclerotic superficial fem. obstruction	32	Nylon bypass	5/16	Acute failure	0	Tiny popliteal, severe thickening and poor run-off
23	A. C.	Nov. 1956	Arteriosclerotic superficial fem. obstruction	30	Nylon bypass	5/16	Acute failure	0	Popliteal very difficult, poor run-off
24	D. H.	Nov. 1956	Arteriosclerotic superficial fem. obstruction	28	Nylon bypass	5/16	Late thrombosis	4 mos.	Popliteal anastomosis difficult, good D.P. pulse for 4 mos. after occlusion required amputation
25	M. L.	Dec. 1956	Arteriosclerotic superficial fem. obstruction	32	Nylon bypass	5/16	Success	1 yr.	No claudication, good pedal pulses
26	P. M.	Dec. 1956	Arteriosclerotic superficial fem. obstruction	30	Nylon bypass	5/16	Success	1 yr.	No claudication, good pulses
27	W. H. P.	Dec. 1956	Arteriosclerotic iliac, femoral obstruction	46	Nylon bypass	5/16	Late failure	6 mos.	Graft from common iliac to popliteal, good P.T. pulse 6 mos., returned to original degree of claudication
28	J. G.	Dec. 1956	Arteriosclerotic superficial fem. obstruction	33	Nylon bypass	5/16	Success	1 yr.	Good pulses, no claudication
29	S. G.	Jan. 1957	Arteriosclerotic superficial fem. obstruction	31	Nylon bypass	5/16	Success	1 yr.	Gangrenous ulcer on toe healed, popliteal but no pedal pulse
30	R. S.	Feb. 1957	Arteriosclerotic superficial fem. obstruction	30	Nylon bypass	5/16	Success	11 mos.	Popliteal pulse returned, no pedal pulse, no further claudication
31	J. S. B.	Apr. 1957	Arteriosclerotic external iliac and femoral obst.	35	Nylon bypass	5/16	Acute failure	0	Poor run-off, popliteal anastomosis difficult, leg worse postoperatively
32	M. M.	June 1957	Arteriosclerotic R. superficial femoral obst.	31	Nylon bypass	5/16	Success	7 mos.	Good pedal pulses, no claudication
33	M. M.	June 1957	Arteriosclerotic L. superficial femoral obst.	32	Nylon bypass	5/16	Success	7 mos.	Good pedal pulses, no claudication
34	S. C.	July 1957	Arteriosclerotic superficial fem. construction	31	Nylon bypass	5/16	Acute failure	0	Difficult popliteal anastomosis, thick wall of artery, tiny lumen, leg worse postop.
35	R. L.	July 1957	Arteriosclerotic superficial fem. obstruction	30	Nylon bypass	5/16	Acute failure	0	Graft sutured to popliteal below knee, poor run-off, leg no worse postoperatively
36	W. M.	July 1957	Arteriosclerotic R. superficial femoral obst.	35	Nylon bypass	5/16	Success	6 mos.	Graft sutured to popliteal below knee, good pulse in graft, no pedal pulse, no claudication

TABLE I.—SUMMARY OF 51 CASES OF PERIPHERAL ARTERY GRAFTS (DURATION OF PATENCY IS LISTED AS OF JANUARY 15, 1958)—Continued

No.	*Initials*	*Date of insertion*	*Indication for graft*	*Length of graft, cm.*	*Type of graft*	*Inside diameter, in.*	*Result*	*Duration of patency*	*Remarks*
37	W. M.	July 1957	Arteriosclerotic L. superficial femoral obst.	34	Nylon bypass	5/16	Success	6 mos.	Graft sutured to popliteal below knee, good pulse in graft, no pedal pulse, no claudication
38	G. Y.	July 1957	Popliteal aneurysm	10	Nylon replacement	3/8	Success	6 mos.	Good pedal pulses
39	T. H.	Sept. 1957	Popliteal aneurysm	8	Nylon replacement	3/8	Success	4 mos.	Good pedal pulses
40	H. A.	Aug. 1957	Popliteal pistol injury	15	Nylon replacement	5/16	Success	5 mos.	Good pedal pulses
41	S. C.	Aug. 1957	Crutch aneurysm axillary	8	Nylon replacement	1/4	Success	5 mos.	Good radial pulse, crutch aneurysm which thrombosed, immediate replacement
42	M. L. W.	Sept. 1957	Arteriosclerotic superficial fem. obstruction	30	Nylon bypass	5/16	Success	4 mos.	Good pedal pulses, no further claudication
43	J. B.	Oct. 1957	Shotgun wound superficial fem.	10	Nylon replacement	5/16	Success	3 mos.	Good pedal pulses, no claudication
44	W. H.	Oct. 1957	Arteriosclerotic superficial fem. obstruction	41	Teflon bypass	5/16	Success	3 mos.	Sutured to popliteal below the knee, good pedal pulses, no claudication
45	P. M.	Oct. 1957	Arteriosclerotic superficial fem. obstruction	20	Teflon bypass	5/16	Success	3 mos.	No further claudication, good pedal pulses
46	S. E. G.	Nov. 1957	Arteriosclerotic superficial fem. obstruction	39	Teflon bypass	5/16	Success	2 mos.	No further claudication, good pedal pulses
47	G. R.	Nov. 1957	Arteriosclerotic superficial fem. obstruction	15	Teflon bypass	5/16	Success	2 mos.	No further claudication, good pedal pulses
48	L. C.	Nov. 1957	Arteriosclerotic popliteal obst.	15	Teflon bypass	5/16	Success	2 mos.	No further claudication, good pedal pulses
49	J. M.	Dec. 1957	Arteriosclerotic superficial fem. obstruction	28	Teflon bypass	5/16	Success	1 mo.	Good pedal pulses, other leg previously amputated
50	J. S.	Dec. 1957	Arteriosclerotic superficial fem. obstruction	29	Teflon bypass	5/16	Success	1 mo.	Good pedal pulses, other leg amputated
51	J. M. A.	Dec. 1957	Arteriosclerotic superficial fem. obstruction	30	Nylon bypass	5/16	Success	1 mo.	Good pedal pulses, no claudication

cut end of the tube to prevent fraying. This leaves a rather stiff end to suture and tends to make a difficult small anastomosis more troublesome. To control nylon porosity properly, enough formic acid solution has been required to result in a fairly thick walled stiff graft. One criticism leveled at nylon has been the gradual loss of tensile strength after being imbedded in body tissues. Animal experiments in our laboratory have revealed that this loss is related to the size of the nylon fiber tested or used. Nylon of 70 denier size rapidly loses up to 80 per cent of its original tensile strength in 6 or 12

months as pointed out by Harrison (7) and confirmed in this laboratory (1). Nylon yarn of 210 denier as used in the crimped tubes shows very much less tensile strength loss even up to 2 years after implantation in animal or man. The superior retention of tensile strength by the larger 210 denier fiber is undoubtedly related to the smaller surface exposure per unit weight to the corrosive effect of tissue fluids. The nylon fiber is so strong originally that this 20 to 30 per cent loss is not significant or dangerous. Nevertheless, it seems obvious that the ideal graft should retain its original strength with the passage of time. Certainly this moderate loss of strength is superior to most arterial homografts, in which the only strengthening bulwark, the elastic fibers fragment and disappear within 1 or 2 years. Dilatation and loss of tensile strength in femoral homografts seems especially severe according to Szilagyi.

In attempting more closely to approach the ideal in a synthetic graft, knitted tubes of teflon have been produced with crimps set by a high temperature bake rather than by chemical reaction. As pointed out by Harrison (6), and Girvin and Merendino (4, 5), and others, teflon has proved superior to all other synthetics in arterial grafts in animals. There has been almost zero tissue reaction, healing of the neo-intima has been rapid and thus far it is the only fiber tested which has shown absolutely no tensile strength loss up to 2 years. Teflon (tetrafluorethylene) is one of the most inert plastics yet discovered; it will withstand boiling nitric or sulfuric acid with no chemical change or loss of strength; it has become known as "dragon's fur" to the chemist. Teflon is extremely unwettable, a highly desirable characteristic in arterial substitutes. Nylon absorbs up to 4 per cent unit weight of water, teflon absorbs none. This water repellent property of teflon reduces the amount of bleeding for a given degree of porosity as compared with nylon. A certain degree of porosity is essential to allow rapid healing and firm attachment of the neo-intima, since a healed adherent lining is the best insurance against thrombosis. The teflon tubes must, therefore, be preclotted with the patient's blood before insertion. This is usually done by dipping the graft in a basin containing 20 to 30 cubic centimeters of the patient's blood, massaging the tube, and allowing blood to coat thoroughly the outside of the graft. Removal of the distal clamps, followed by a 30 second wait before removing the proximal clamp will minimize blood loss. If weeping through the pores is still troublesome, the proximal clamp is reapplied for a few seconds.

The crimped teflon tube is much softer, more pliable, and easier to suture than crimped nylon. The knit construction suggested by Sanger allows suturing of the cut end without the necessity of heat-sealing. Careful control of porosity has greatly reduced the bleeding problem. Many animal experiments and our early clinical experiences have led us to believe that this tube much more closely approaches the ideal than braided nylon.

Acute thrombosis is related usually to stasis of blood in the graft due to sluggish run-off distally, or to technical errors resulting in projecting edges which trap fibrin. Early postoperative thrombosis may occasionally be due to compression of the graft by sleeping with legs crossed or some other mechanical factor. More frequently, however, thrombosis in the first few days or weeks is due to the partial detachment of the neo-intima which swings down and occludes the lumen. Therefore, early attachment of the lining is desirable. Teflon tubes with controlled porosity allow attachment of the lining in 1 to 2 months in comparison with nylon tubes whose fibrin lining becomes healed and secure in 4 to 6 months.

Late thrombosis after 6 months may be due to progression of arteriosclerotic plaques just proximal or distal to the graft. Areas of arterial injury, such as those due to artery clamps are particularly vulnerable locations for further plaque formation. Synthetic grafts do not seem to be susceptible to atherosclerotic changes that have been ob-

served in arterial homografts or long autogenous vein grafts. A number of postoperative arteriograms have been performed on our patients with functioning grafts 6 months to 2 years after operation. All have shown a smooth graft lumen without areas of stenosis. There will undoubtedly continue to be cases of late thrombosis despite the type of graft used until a method of retarding the progress of arteriosclerosis is found. One of our patients (J. B. No. 11 and 12) was one of the few placed on a low fat diet and daily estrogen therapy after his graft operation. Despite this he had a mild coronary thrombosis 1 year after operation and 1 femoral graft thrombosed at 18 months.

SUMMARY

Fifty-one cases of peripheral artery grafts of crimped nylon or teflon are reported over a 3 year period.

There were 12 replacement grafts for arterial injuries or peripheral aneurysms, all of which functioned satisfactorily.

Thirty-eight bypass grafts were performed for obliterative arteriosclerosis with acute thrombosis of 7 and late occlusion in 4.

A new crimped tube of knitted teflon was used in the last 7 bypass grafts. This graft is easier to handle and suture than crimped nylon and is made of the most inert synthetic fiber now known.

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ALTERATIONS IN BLOOD AMMONIA IN DOGS FOLLOWING TOTAL HEPATECTOMY AND ABDOMINAL EVISCERATION

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THERE IS abundant evidence establishing a relationship between hepatic coma and elevations of blood ammonia. The correlation between blood ammonia and liver dysfunction was first recognized by Bollman and Mann in 1930. They noted a progressive rise in blood ammonia after total hepatectomy in dogs and demonstrated that removal of the gastrointestinal tract prevented this rise to a large degree, indicating that it was the major source of ammonia.

The typical biochemical and clinical findings after total hepatectomy in the dog have been well documented by Mann (8), Markowitz and associates (10) and by Fisher. It has been shown that after hepatectomy the total carbon dioxide continues to fall slowly until death of the animal 12 to 24 hours later. On the basis of this falling bicarbonate level, it has been assumed that the dogs exhibit progressive metabolic acidosis. Early in the postoperative period neurologic abnormalities appear which respond quite readily to the administration of glucose (first stage symptoms). Later in the course of the hepatectomized dog, a group of second stage symptoms appears (semicoma, ataxia, and blindness). These symptoms do not respond to additional glucose or other known medications. Terminally, the dog has respiratory arrest before cardiac arrest and the cause of eventual death has not been specifically established.

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The mechanism by which ammonia produces coma or other neurologic abnormalities has been presumed to be that of interference in intermediate carbohydrate metabolism in all tissues. Excess ammonia probably depletes alpha-ketoglutaric acid and thereby retards reactions in the Krebs cycle. On the basis of this hypothesis ammonia toxicity has been effectively treated clinically with glutamic acid or monosodium glutamate. The mechanism of action that has been proposed is the removal of excess ammonia by amidation to produce glutamine. Arginine hydrochloride has also been subjected to clinical trial in the management of ammonia toxicity. It was reported to be of definite value by Najarian and Harper (11), and they explained the mechanism of ammonia removal by a series of reactions associated with urea production.

Although the liver plays a major role in ammonia detoxification in both normal and abnormal states, the arteriovenous cerebral and peripheral ammonia difference noted in clinical states of ammonia toxicity also implies a continuous removal of ammonia by tissues other than the liver. To elucidate various features of ammonia toxicity, and to establish the site of action of the drugs used in the treatment of ammonia toxicity, the experiments reported here were carried out by using dogs that had been subjected to total hepatectomy or abdominal evisceration.

METHODS

Total hepatectomy was carried out in 23 dogs by methods described by Markowitz

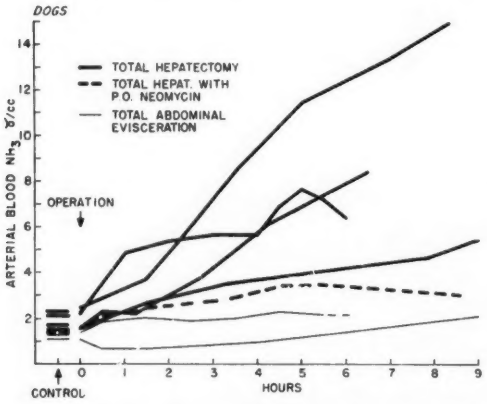

FIG. 1. Arterial blood ammonia levels following total hepatectomy and abdominal evisceration.

(9). Both one stage and multiple stage methods were used and the dogs were usually fed until the day of surgery. For the one stage hepatectomies the hepatic vena cava was replaced with a polyethylene tube and a portacaval anastomosis established before total removal of the liver. For the multistage procedures, the portal vein and inferior vena cava were encircled with partially constricting cellophane ligatures at a first stage operation to establish an adequate collateral blood flow. This method allowed delayed ligation of these structures prior to hepatectomy. One of the dogs was treated with an intestinal antibiotic (neomycin) for 5 days prior to total hepatectomy. Total abdominal evisceration was carried out in 8 dogs with the technique described by Markowitz (9). The hepatic vena cava was replaced by a polyethylene tube and all the abdominal viscera except the adrenal glands were excised. This operation included bilateral nephrectomy.

All dogs subjected to these surgical procedures had ether anesthesia and blood transfusion during the course of the operation. They awoke from anesthesia quite alert in most instances and were maintained on hourly intravenous administration of glucose (0.25 to 0.50 gm./kgm.) during the remainder of the experimental period. Prior to surgery, and at hourly intervals following surgery, heparinized blood samples were drawn through previously placed arterial catheters for determination of blood *p*H, total plasma carbon dioxide, and total blood ammonia. Whole blood *p*H, was determined with a Cambridge condensor type glass electrode surrounded by a constant temperature water jacket at 37 degrees C. and total carbon dioxide was determined by the method of Van Slyke and Neill. Blood ammonia was determined by a modification of the Conway method described by Seligson and Seligson.

Five totally hepatectomized dogs were followed up without treatment to determine the natural course of the blood chemical findings following this operation. Six dogs were subjected to the same experimental procedure, but given monosodium glutamate (20 to 25 gm.) when blood ammonia was definitely elevated. Five dehepatized animals were given arginine hydrochloride (15 to 25 gm.) and 3 received sodium alpha-ketoglutarate (20 to 25 gm.). These drugs were administered intravenously in 200 cubic centimeters of 5 per cent dextrose with *p*H adjusted to 6 to 7 with sodium hydroxide. Two dehepatized dogs were treated with sodium bicarbonate only (4 and 12 gm.).

Two of the eviscerated dogs were observed without treatment other than glucose injections. Ammonium acetate dissolved in 20 cubic centimeters of 5 per cent dextrose was administered intravenously to the other 6 eviscerated dogs (23 to 153 mgm./kgm.), over a 5 to 15 minute period. Blood samples were drawn at 15 to 30 minute intervals following injection. The increase in ammonia nitrogen in the extracellular fluid was calculated from the increase in the blood ammonia level and the estimated extracellular fluid volume.[1] In 2 experiments inulin space was used as an estimate of extracellular fluid volume. In the remainder of the experiments the extracellular fluid

[1]Plasma ammonia values in our laboratory have been slightly lower than simultaneously determined whole blood ammonia values. However, this difference did not significantly alter the calculations of total extracellular ammonia.

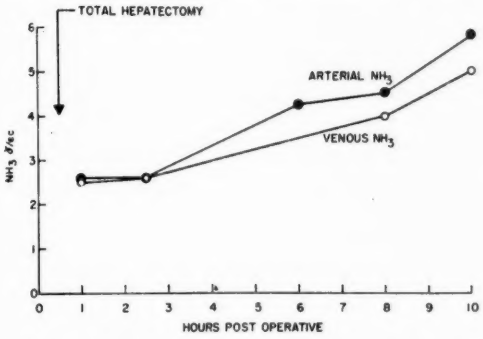

FIG. 2. Arteriovenous ammonia difference following total hepatectomy (dog).

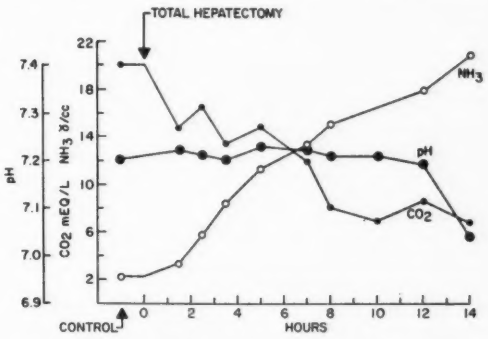

FIG. 3. Arterial blood ammonia, *p*H, and CO_2 following total hepatectomy (dog).

was assumed to be 20 per cent of initial body weight, despite the surgical absence of the abdominal viscera.

RESULTS

Postoperative clinical and biochemical findings. The clinical findings in "untreated" animals after total hepatectomy were similar to those previously described by others. The first stage symptoms were not usually seen, as all dogs were given intravenous glucose immediately following surgery, and until the completion of the experiments. First-stage symptoms were occasionally seen when glucose administration was inadequate, and in several instances this inadequacy led to death of the animal. The second stage symptoms appeared from 6 to 15 hours following total hepatectomy and progressed until death.

The change in blood ammonia following total hepatectomy was a progressive rise from the time of anesthesia until the death of the animal (Fig. 1). The rate at which this rise occurred was variable and could not be well correlated with clinical state. If shock developed from postoperative bleeding, however, the elevation in blood ammonia was definitely more rapid than if shock did not occur. The 1 animal subjected to neomycin bowel preparation prior to hepatectomy had a very slow rise in blood ammonia but its clinical course was similar to the other preparations. Terminally this dog exhibited all the second stage symptoms but its blood ammonia was still only 3 gammas per cubic centimeter. In 4 experiments in which simultaneous measurements were made, the arterial ammonia was up to 1 gamma per cubic centimeter higher than the venous level (see Fig. 2). The typical changes in plasma carbon dioxide and *p*H are shown in Figure 3 and are indicative of metabolic acidosis throughout the entire postoperative period.

"Untreated" animals after abdominal evisceration had a similar course to that described for totally hepatectomized dogs. The changes in *pH* and plasma carbon dioxide were also quite similar. The blood ammonia rose quite slowly, however, and never reached elevations greater than 3 gammas per cubic centimeter (Fig. 1).

The effect of administration of glutamate, alpha-ketoglutarate, and arginine to hepatectomized dogs. The changes in blood ammonia in the 6 dogs given intravenous monosodium glutamate at various times following total hepatectomy are shown in Table I and Figures 4 and 5. In 4 of 6 experiments, the blood ammonia fell to significantly lower levels than preinjection values, and in the remaining 2 dogs the progressive rise of blood ammonia was delayed. The decrease in blood ammonia was transient and after 30 to 90 minutes the ammonia again began to rise. During this period the dogs showed no improvement in clinical status and ad-

TABLE I.—CHANGES IN ARTERIAL AMMONIA, *p*H, AND CO_2 BEFORE AND AFTER ADMINISTRATION OF VARIOUS DRUGS TO DEHEPATIZED DOGS

		NaHCO₃		*Na glutamate*						*Na alpha-ketoglutarate*			*Arginine HCL*				
Dog No.		*H7*	*H23*	*H5*	*H6*	*H16*	*H17*	*H18*	*H19*	*H10*	*H22*	*H21*	*H13*	*H14*	*H15*	*H19*	*H22*
90-120 min. prior to "treatment".	*p*H	7.41	7.40	7.31	7.24	7.17		7.31	7.38	7.29	7.25	7.51	7.38	7.28	7.29	7.32	
	CO_2 mEq./L.	19.4	18.3	21.2	14.4	10.5		7.6	12.2	12.6	11.8	17.8	15.2	13.6			
	NH_3 γ/c.c.	3.8	2.7	5.5	6.8	6.9		5.6	3.8	4.7	3.5	5.5	4.8	3.6	7.0	3.4	
Immediately prior to "treatment".	*p*H	7.40	7.40	7.34	7.32	7.18	7.31	7.11	7.29	7.27	7.26	7.42	7.37	7.35	7.31	7.37	7.40
	CO_2 mEq./L.	18.1	19.8	17.5	15.9		16.9	8.2	11.4	10.9	13.7		15.2	14.1			19.0
	NH_3 γ/c.c.	4.5	3.1	6.9	7.8	9.1	5.0	7.5	3.9	5.8	4.3	10.0	5.1	3.2	8.5	4.0	2.4
Treatment ...	Time P.O.	9′	6′	12′	3′30″	4′	5′30″	4′	4′	10′	3′15″	3′	8′30″	5′30″	6′15″	10′	6′
	Dose (gms.)	4	12	16	20	25	21	21	20	25	25	25	20	20	15	20	20
	Duration	10″	30″	3′20″	1′30″	1′	1′	1′	1′	30″	30″	1′	15″	30″	45″	30″	20″
30 min. after drug initiated....	NH_3 γ/c.c.		1.8 (7.57)		5.9				3.2	2.6	3.6	10.3	6.6	3.2		3.6	3.0
60 min. after drug initiated....	*p*H	7.52		7.41	7.33	7.26	7.26	6.90	7.24		7.27		7.32		7.12		7.40
	CO_2 mEq./L.	22.7		20.6		13.5	15.1	8.2	12.8		14.8		11.8				20.9
	NH_3 γ/c.c.	4.4		5.2	5.1	9.0	3.6	8.0	2.5	3.2	2.9		8.7		11.5		3.4
90-120 min...	*p*H	7.53	7.53		7.28	7.34	7.25	6.95	7.32	7.34	7.40		7.32	7.26	6.96	7.30	
	CO_2 mEq./L.	21.8	31.6		17.2	16				15.8	19.0			9.2	5.6		
	NH_3 γ/c.c.	5.0	3.1		4.8	8.2	4.9	6.4	2.8	3.0	2.5		10.4	5.0	12.5	4.5	
180-240 minutes.....	*p*H		7.53	7.57	7.30	7.41			7.36	7.39	7.40	7.26		7.14		7.30	7.34
	CO_2 mEq./L.		29.1	18.6	15.7	22.4			13.2	12.6		15.9		5.6			
	NH_3 γ/c.c.		3.6	4.8	4.6	8.1			3.2	3.6	2.40	7.9		6.9		8.1	3.7
NH_3 response to treatment..		±	±	↓	↓	±	↓	±	↓	↓	↓	↓	↑	↑	↑	±	↑
		NaHCO₃				Na glutamate				Na alpha-ketoglutarate			Arginine HCl				

ministration of these drugs did not seem to alter the course of the experiments other than by these blood findings. There was a small delayed rise in *p*H following glutamate administration to 2 dogs, but there was usually no significant change in *p*H following injection (Table I). The results following sodium alpha-ketoglutarate administration to 3 hepatectomized dogs were quite similar to those obtained with monosodium glutamate (Table I and Fig. 6). Again there was no obvious change in the dogs' general behavior following drug administration despite a definite decrease in blood ammonia.

Arginine hydrochloride (with *p*H adjusted to 6 to 7) was administered to 5 dogs as described and in none of these dogs was there any decrease in blood ammonia level (Table I and Fig. 7). Each of these dogs seemed to deteriorate more rapidly following drug administration and this deterioration was associated with a small elevation of blood ammonia. Two hepatectomized dogs that failed to demonstrate a decrease in blood ammonia after arginine did have a significant fall in blood ammonia following monosodium glutamate and sodium alpha-ketoglutarate administration (Figs. 8 and 9).

Sodium bicarbonate was administered in a dosage of 4 grams and 12 grams to 2 hepatectomized dogs (Table I). Blood *p*H rose markedly and a transient fall in blood ammonia was associated with this acute change (Fig. 10). The acute alkalosis produced was not sustained in these dehepatized dogs and the blood ammonia continued to rise at the expected rate.

Tolerance of eviscerated dogs to exogenous ammonium salts. The serial blood ammonia levels following intravenous administration of ammonium acetate (50 to 80 mgm./kgm.) to 4 of the eviscerated dogs are shown in Figure 11. After an initial postinjection rise in each experiment, a rapid fall in blood ammonia occurred over a 2 to 4 hour period. A similar disappearance of ammonia was observed after repeated injection of a smaller quantity (Fig. 12). After injection of a larger quantity in 1 dog (153 mgm./kgm.) the subsequent fall in blood ammonia was similar, but less profound, and persistent coma occurred following injection. There was no significant change in blood urea (Table II).

Two to 4 hours after ammonium acetate administration (23 to 80 mgm./kgm.) only 0.6 to 5 per cent of this ammonia nitrogen could be accounted for in the extracellular fluid (Table II). Two hours after the larger, apparently fatal injection (153 mgm./kgm.) only 7.2 per cent of the injected ammonia nitrogen could be accounted for in the extracellular fluid.

DISCUSSION

These studies have confirmed the finding of Bollman and Mann of a progressive rise in blood ammonia after total hepatectomy in the dog. This was usually more rapid than they described, but a major difference in our experiments was the absence of a preoperative fasting period. The progressive fall in *p*H and total carbon dioxide that was observed following removal of the liver was indicative of a metabolic acidosis and not of the respiratory alkalosis that is commonly observed with clinical ammonia toxicity.

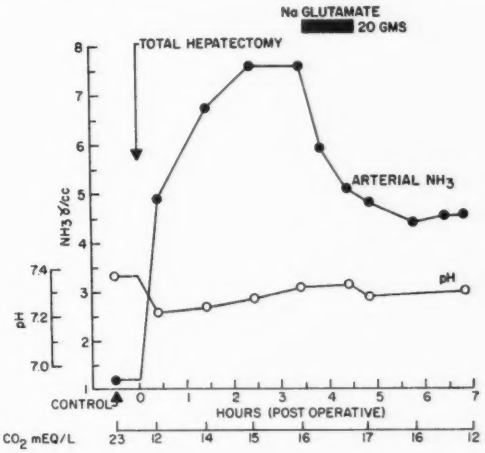

FIG. 4. Change in arterial blood ammonia, *p*H, and CO_2 in dehepatized dog after treatment with 20 grams of monosodium glutamate.

The absence of a good correlation between ammonia levels and the course of the dehepatized dogs stresses the importance of the many other metabolic defects that accompany advanced liver failure. The significance of these defects is further emphasized by the lack of a favorable clinical response to lowering blood ammonia with drugs. Whereas Eck fistula dogs might seem analogous to patients with cirrhosis, who char-

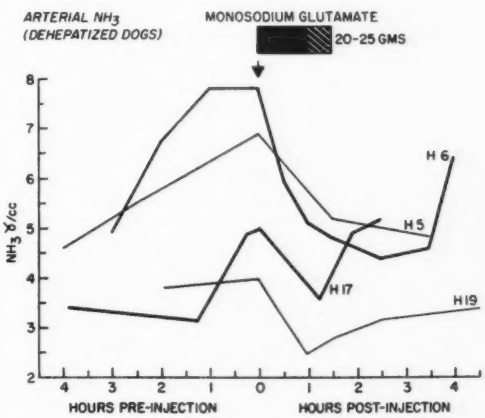

FIG. 5. Decrease in arterial blood ammonia after administration of 20 to 25 grams of monosodium glutamate to dehepatized dogs.

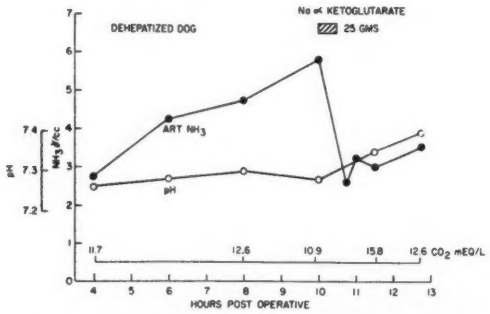

FIG. 6. Change in arterial blood ammonia, *p*H, and CO_2 in dehepatized dog after treatment with 25 grams of sodium alpha-ketoglutarate.

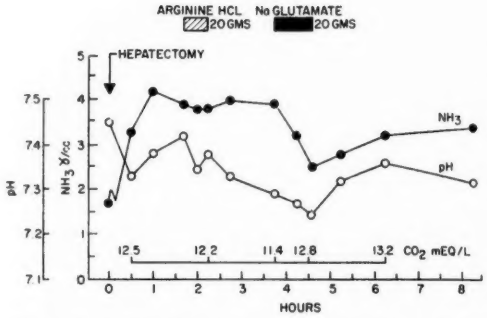

FIG. 8. Arterial blood ammonia, *p*H, and CO_2 in dehepatized dog treated with arginine hydrochloride and monosodium glutamate.

acteristically have portal-systemic shunts, these hepatectomized dogs were more similar to patients with acute yellow atrophy of the liver. Ammonia seemed to play a lesser role than other metabolic problems following hepatectomy.

Monosodium glutamate and sodium alpha-ketoglutarate, each of which should theoretically produce similar findings, both resulted in a significant decrease in blood ammonia in the dehepatized dogs. Marked elevation of blood *p*H has also been shown to produce a decrease in blood ammonia in dogs (7). In line with this observation, a very transient fall in blood ammonia was seen with acute elevation of *p*H after administration of sodium bicarbonate to hepatectomized dogs. Although monosodium glutamate injection was associated with delayed rise in *p*H in 2 of the 6 experiments, this elevation was small and inconstant, and could not be responsible for the decrease in blood ammonia observed.

The ineffectiveness of arginine hydrochloride in removing ammonia in dehepatized dogs was in marked contrast to the findings in Eck fistula dogs reported by Najarian and Harper(12). Our findings do not refute the hypothesis for arginine action proposed by these authors(11), however. Their schema for ammonia removal by arginine involves urea production, and this

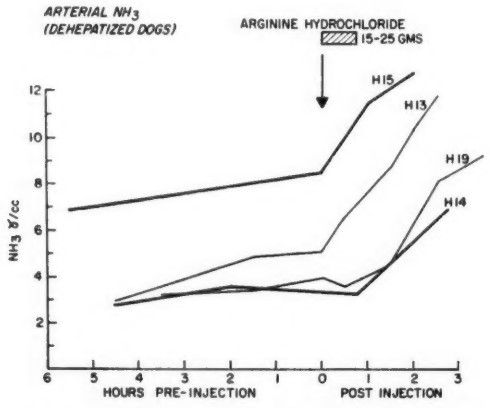

FIG. 7. Arterial blood ammonia after administration of 15 to 25 grams of arginine hydrochloride to dehepatized dogs.

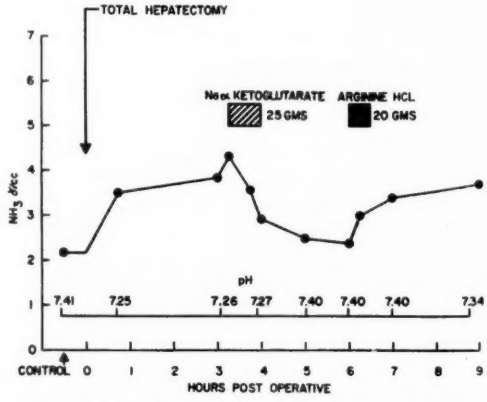

FIG. 9. Arterial blood ammonia and *p*H in dehepatized dog treated with sodium alpha-ketoglutarate and arginine hydrochloride.

requires the presence of a functioning liver. The deterioration in the clinical state of the dogs following injection of arginine may have been related to the small concurrent increase in blood ammonia that was observed, but 4 of these 5 dogs had some decrease in *p*H. This fact might have contributed to the elevation of blood ammonia. In spite of an increase in total ammonia, a decrease in *p*H should actually lower the PNH_3 form (free ammonia) and thereby ameliorate the symptoms of ammonia toxicity. This finding suggests that the deleterious effect of arginine probably had no relationship to ammonia.

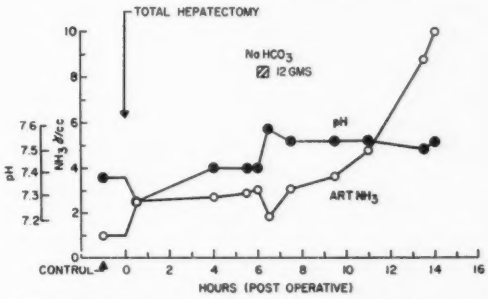

FIG. 10. Arterial blood ammonia and *p*H in dehepatized dog treated with 12 grams (132 mEq.) of sodium bicarbonate.

The striking difference between the progressively rising blood ammonia levels following total hepatectomy and the low levels observed after abdominal evisceration emphasized the importance of the gastrointestinal tract in terms of the total body economy of ammonia. This observation was confirmed by the findings after hepatectomy in the dog that had bowel preparation with neomycin. The persistently low ammonia levels following abdominal evisceration also provided an opportunity to study the peripheral detoxifying mechanisms for ammonia.

The blood ammonia curves following ammonium salt administration to eviscerated dogs bore a striking similarity to the ammonia tolerance curves reported in patients with intact livers by White and associates. The quantity of ammonia nitrogen administered in relation to body weight of the human subjects as reported by these investigators was in the same range as the dosage used in the experiments reported here. There is no question that the liver is a major site of removal of exogenous ammonia, but the similarity of disappearance curves in eviscerated, liverless animals raises strong objections to the use of ammonia tol-

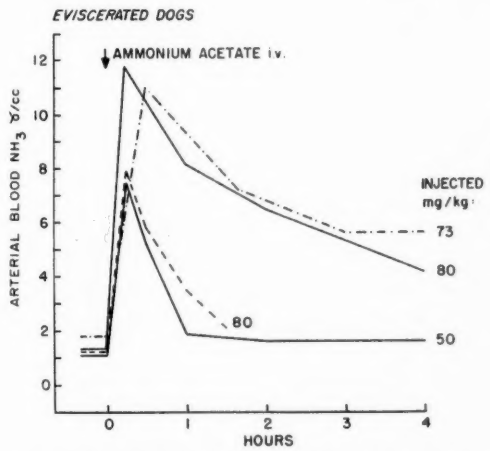

FIG. 11. Arterial blood ammonia following intravenous administration of ammonium acetate (50 to 80 mgm./kgm.) to 4 eviscerated dogs.

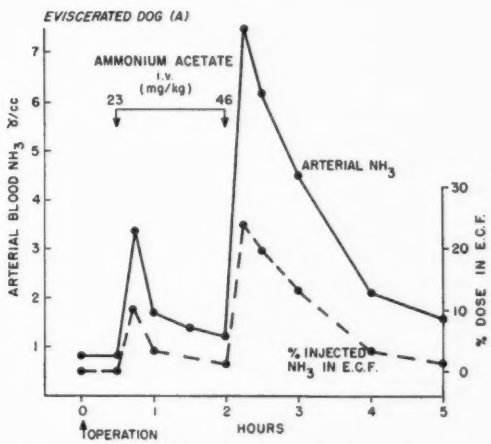

FIG. 12. Arterial blood ammonia subsequent to the repeated administration of ammonium acetate to eviscerated dog.

TABLE II.—CHANGES IN BLOOD AMMONIA, *p*H, CO_2, UREA, AND TOTAL EXTRACELLULAR FLUID AMMONIA AFTER ADMINISTRATION OF AMMONIUM ACETATE TO EVISCERATED DOGS

Dog		*Control blood ammonia*		*Ammonium acetate injected*		*Minutes following I.V. ammonium acetate*					
No.	*Wt. and E.C.F.*	*Time P.O.*	*γ/c.c.*	*mgm./kgm.*		*15″*	*30″*	*60″*	*90″*	*120″*	*240″*
C1	16	30″	0.7		Arterial NH_3 (γ/c.c.)			0.7			1.0
C2	17	30″	1.9		Arterial NH_3 (γ/c.c.)			2.1		1.9	2.3
A	13 (2.6L)	10″	0.8	23	Arterial NH_3 (γ/c.c.)	3.4	1.7	1.4	1.2		
					% Inj. NH_3-N in E.C.F.	10.3	3.5		1.6		
		120″	1.2	46	Arterial NH_3 (γ/c.c.)	7.3	6.2	4.5		2.1	1.6
					% Inj. NH_3-N in E.C.F.	24	19.7	13		3.5	1.6
B	13 (2.6L)	30″	1.25	79	Arterial NH_3 (γ/c.c.)	7.9	5.8	3.5	2.1		
					% Inj. NH_3-N in E.C.F.	7.8	5.3	2.7	1.0		
					*p*H (arterial)	7.35	7.34	7.34	7.29		
					CO_2 mEq./L	24	23	21	17		
C	19 (3.8L)	120″	1.3	78	Arterial NH_3 (γ/c.c.)	11.7	7.7	8.2		6.5	4.2
					Venous NH_3 (γ/c.c.)	12.4	6.6	8.6		6.7	4.5
					% Inj. NH_3-N in E.C.F.	17.9	11.0	11.9		9.0	5.0
					*p*H (arterial)	7.31	7.35	7.20		7.03	7.22
					CO_2 mEq./L.	11.8	8.4	7.5		5.7	4.8
D	13 (2.6L)	120″	1.2	153	Arterial NH_3 (γ/c.c.)	42	27	24		19	
					Venous NH_3 (γ/c.c.)	40	27	23		20	
					% Inj. NH_3-N (in E.C.F.)	16.6	10.5	9.3		7.2	
E	16 (1.7L)	30″	1.8	80	Arterial NH_3 (γ/c.c.)		11.0		7.2	5.6	5.6
					Venous NH_3 (γ/c.c.)			11.5		5.6	5.6
					% Inj. NH_3-N in E.C.F.		5.9		3.5	2.4	2.4
					*p*H (arterial)		7.24	7.24	7.28	7.19	7.08
					CO_2 mEq./L		11.3		8.8	7.4	5.3
					B.U.N.-mgm.% (14.0)	14.3	14.3		15.7	13.0	14.1
F	30 (3.9L)	40″	1.1	50	Arterial NH_3 (γ/c.c.)	7.5	5.1	1.9		1.6	
					% Inj. NH_3-N in E.C.F.	7.6	4.8	0.9		0.6	
					*p*H (arterial)	7.28	7.28	7.28		7.21	
					CO_2 mEq./L.	12.5	13.1	12.7		11.6	
					B.U.N.-mgm.% (20.1)		27.2	23.6		21.9	21.5

erance curves for clinical evaluation of liver function.

An unequal distribution of total ammonia between intracellular and extracellular compartments at equilibrium is undoubtedly partially responsible for the low values for total extracellular ammonia shown in Table II. The distribution of total ammonia between the intracellular and extracellular space, in terms of concentration, has been reported to be roughly 4:1 (3)[2]. Since intracellular water is approximately 2 times the volume of extracellular water, we would expect the total intracellular ammonia to be approximately 8 times the total extracellular ammonia. From such calculations one might derive an estimate of total body ammonia. This would be higher than the true total ammonia since no allowance is made for absence of the significant area of distribution in the abdominal viscera. Even ignoring this and considering the intracellular-extracellular distribution of ammonia as 8:1, we could account by calculation for only 5 to 45 per cent of the ammonia administered to these dogs. The curves of decreasing blood ammonia following ammonium acetate administration are, therefore, a graphic representation of the net result of intracellular transfer of ammonia, and ammonia removal by metabolic processes. Since intracellular transfer of ammonia can account at most for only a fraction of that removed, the peripheral detoxification mechanisms assume real significance.

Bessman and Bessman reported a peripheral arteriovenous ammonia difference in patients with ammonia toxicity, and we found this to be so in our hepatectomized dogs. The significance of the peripheral tissues as a site of ammonia removal is also emphasized by our findings following ammonium salt administration to eviscerated dogs. Flock and associates studied amino acid concentrations after total hepatectomy in dogs and demonstrated a progressive increase in glutamine and a progressive decrease in glutamic acid concentration in muscle. In view of the ability of monosodium glutamate to lower blood ammonia in the absence of the liver, these amino acid changes in tissues suggest a peripheral mechanism capable of producing the progressive removal of ammonia observed in eviscerated dogs.

[2]At equilibrium intracellular and extracellular PNH_3 must be equal if passage of ammonia across cell membranes occurs as the free ammonia form. The proportion of total ammonia present as free ammonia (or PNH_3) varies as a function of p_H and temperature. (Factors for calculating free ammonia from total ammonia concentration have been described by Jacquez and associates.) If we assume a p_H gradient of 0.6 across the cell membrane, the more acid intracellular space would require almost 4 times the total ammonia concentration found in the extracellular fluid to maintain the equal free ammonia concentrations in these compartments. These theoretic calculations of ammonia distribution corroborate the direct measurements of Christensen and associates.

SUMMARY

1. Dogs subjected to total hepatectomy demonstrated metabolic acidosis and a progressive rise in blood ammonia. In contrast, abdominally eviscerated dogs maintained low blood ammonia levels. These findings re-emphasize the importance of the gastrointestinal tract in the production of ammonia.

2. Monosodium glutamate and sodium alpha-ketoglutarate lowered blood ammonia in dehepatized dogs. These alterations were not dependent on changes in p_H. Despite apparent ammonia removal by means of these drugs, the clinical status or course of these dogs was not changed.

3. There was a small rise in blood ammonia after administration of arginine hydrochloride to dehepatized dogs. There was no clinical benefit noted and probably some deterioration following injection of this drug.

4. Ammonium acetate injected intravenously in abdominally eviscerated dogs is followed by an initial rise in blood ammonia and then a progressive fall toward control values. Only a small portion (0.6 to 5 per cent) of the injected ammonia could be accounted for in the extracellular fluid 2 and 4 hours after administration. These observations stress the importance of peripheral detoxification mechanisms for ammonia.

5. The metabolic defects in dogs associ-

ated with total hepatectomy or abdominal evisceration are obviously multiple and treatment of ammonia toxicity alters only one phase of the problem. The lack of dependence on the liver for the action of monosodium glutamate suggests, however, that this drug may be more useful than arginine in the treatment of ammonia toxicity associated with severe liver impairment.

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THE EFFECT OF SUTURE MATERIAL ON SMALL ARTERY ANASTOMOSES

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THROUGHOUT the surgical literature the use of fine silk has been firmly established as a satisfactory vascular suture material. Our interest in the use of different suture agents stems from previous observations of unfavorable results in small artery grafting procedures, namely, frequent thrombosis and occlusion of small artery homografts. In most instances, the origin of the thrombus was at the line of anastomosis between the host artery and the artery homograft. Because of these findings we investigated three different types of arterial suture material (silk, nylon, and dacron), and although our study did not suggest that one type of suture influenced the patency of such small artery homografts, certain observations regarding these suture materials suggested their further investigation. Therefore, in this article is presented a comparative study between No. 5-0 arterial braided silk, nylon, and dacron suture material as to: (1) gross appearance and function of the anastomosis, (2) strength of anastomosis, (3) stimulus of cellular reaction, (4) comparison of suture tensile strength, (5) knot yielding capacity, and, (6) manageability of these suture agents.

MATERIAL AND METHODS

Healthy mongrel dogs, weighing between 10 and 15 kilograms, were employed in this study. Under aseptic conditions and nembutal anesthesia, the carotid and femoral arteries of these animals were divided and resutured in an end-to-end fashion by the Carrel technique. In each instance, No. 5-0 braided arterial silk, nylon, and dacron suture materials were employed for a total of 45 anastomoses. In addition, an 8 centimeter length of each suture material was imbedded in the adjacent neck or groin area. These animals were sacrificed at intervals varying from 48 hours to as long as 36 days, at which time the segment of the sutured artery was excised and its patency affirmed by irrigating the lumen with normal saline. The strength of the anastomosis was determined by the method of Kroboth, except that the procedure was not carried out in situ. Following this method, the artery segment was divided in its long axis, and the lumen and anastomotic site were inspected for any gross changes. Both segments were then fixed in 10 per cent formaldehyde, stained with hematoxylin and eosin, and examined microscopically. Also, the imbedded segment of suture material was removed, placed in a saline moistened surgical gauze sponge, and within 1 hour tensile strength studies were determined by employing an inclined plane tensiometer.

Tensile strength. Tensile strength studies for silk, nylon, and dacron have been reported by others and our findings are quite similar; namely, dacron and nylon are stronger than silk. In addition we found the tensile strength of each material to be decreased following tissue implantation. This fact was manifest principally during the first 10 days with dacron showing a decrease much in excess of either nylon or silk; however, in no instance did it approach the breaking point of either nylon or silk (Fig. 1).

As noted in Figure 1, the initial tensile strength of silk was greater than that of

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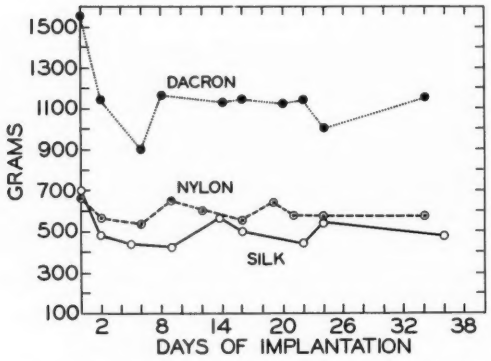


FIG. 1. The effect of tissue implantation on the tensile strength of No. 5-0 braided arterial silk, nylon, and dacron. In each instance a decrease in the tensile strength of each suture occurred.

nylon. However, following tissue implantation the loss incurred by silk was significantly increased over equivalent sized nylon.

Knot yielding and breaking potential. During the course of this experiment, a most common observation was the difficulty encountered in creating a smooth, flat secure knot by conventional surgical knot-tying techniques when nylon or dacron was employed. In many instances, springing apart or loosening of the knot was observed. To circumvent this problem, a surgeon's knot with 3 extra loops or 2 square knots were used to secure the two ends of the suture or to fix the primary suture. We investigated this problem further by determining the yield strength of various knots as well as their slipability. As has been shown by Price, Melick, and Howes, the tensile strength of silk is reduced at the point of the knot. This effect is shown by nylon as well as dacron. However, with nylon a surgical square knot invariably slipped, and although other methods of knot tying produced greater security, they too would occasionally slip at measurements well below the original tensile strength. Dacron and silk exhibited a similar finding but to a lesser degree. In each instance, the presence of a knot appreciably reduced the tensile strength of each suture material (Fig. 2).

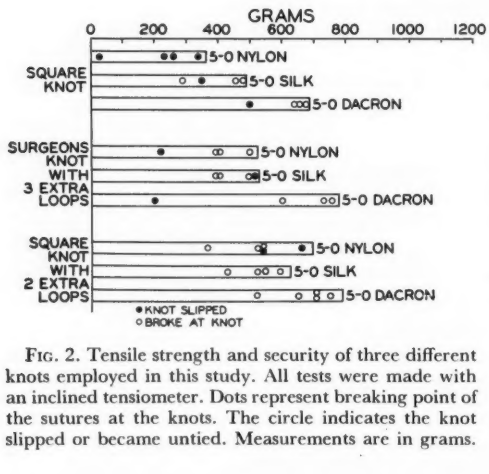
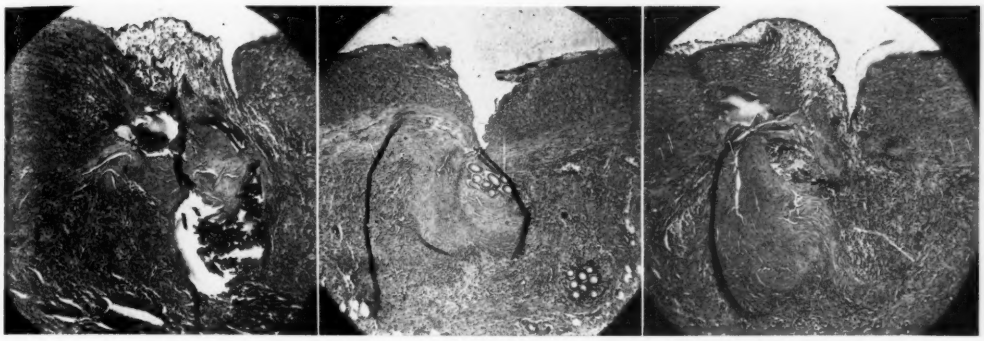


FIG. 2. Tensile strength and security of three different knots employed in this study. All tests were made with an inclined tensiometer. Dots represent breaking point of the sutures at the knots. The circle indicates the knot slipped or became untied. Measurements are in grams.

Gross appearance and function. Of the 45 anastomoses performed in this experiment, 7 were occluded or partially occluded by thrombus formation. This happened in 4 instances when dacron was used, 2 with silk, and 1 with nylon. In each case the thrombus was firmly attached to the suture line. The remaining 38 anastomoses appeared grossly free of thrombus formation; in addition, suture material was visible from the lumen side of the artery and after 3 days appeared covered by a glistening endothelium-like substance. It was our impression, however, that nylon presented a smaller surface area of exposure to the flow of blood than either silk or dacron. In retrospect, it seemed that an anastomosis with dacron showed a definite ridge or suture material protruding from the intimal surface of the anastomosis which was not so apparent with either silk or nylon. This phenomenon suggested a possible factor for the increased incidence of thrombosis when dacron was employed as an arterial suture.

Strength of anastomoses. The strength of the anastomotic site was determined by measuring the millimeters of mercury necessary to produce a rupture. After 48 hours the artery anastomosis, irrespective of the suture material employed, withstood pressures of 250 millimeters of mercury without demonstrating evidence of gross rupture.



a b c

FIG. 3. A histologic section of an artery anastomosis of 6 days' duration. Note the increased edema and cellular reaction incurred by, a, silk, in contrast to the minimal response to, b, nylon and, c, dacron.

Minute air leaks occurred in the region of some anastomoses at pressures varying from 140 to 300 millimeters of mercury. However, it was our impression that the anastomoses created with silk tolerated pressures much in excess of those sutured with nylon or dacron before air leaks occurred. It was highly suggestive that the increased fibrous reaction surrounding the silk-constructed anastomoses may have been responsible for this condition.

In each instance, minor constrictions appeared at the anastomotic site. However, this condition appeared to be related to the artery, rather than to the type of suture material employed. The femoral artery demonstrated this condition immediately after continuity was re-established. Nevertheless, after 30 days, the degree of constriction was essentially the same or slightly less. In like manner, the periarterial fibrous reaction appeared greater whenever the femoral artery was used, but, as has been stated, the employment of silk suture appeared to increase this response over that of either nylon or dacron. This inflammatory reaction, however, did not appear to alter the functional integrity of the resutured artery.

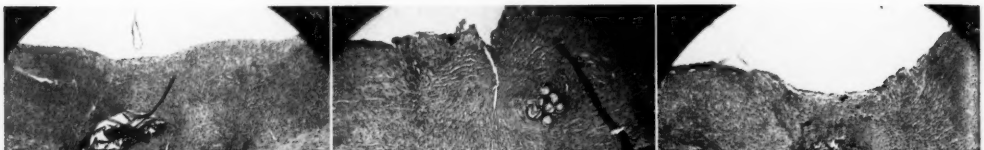
Tissue response. Tissue reaction to the three types of suture material was determined on the basis of three factors, namely: (1) polymorphonuclear response, (2) width of tissue reactions, and, (3) cellular density. In addition, the appearance of fibroplastic activity and the extent of edema present were also noted. These methods of observation are identical to the measures employed by Dettinger and Bowers in their comparison study of tissue response to orlon, dacron, and silk. In general, our investigation complements those authors' results.

In brief, the tissue response to silk, as measured by the polymorphonuclear count and edema, was greater than that observed in either nylon or dacron. This reaction was principally noted during the first 10 days, at which time the inflammatory response was about equal for all 3 sutures.

The zone of tissue reactions about each suture material was determined, and silk was noted to elicit a wider zone of reaction than either nylon or dacron. Similarly, the cellular reaction manifest by the presence of foreign body giant cells, mononuclear cells, and fibroblastic activity was found to be more prolonged when silk was employed. Nylon and dacron incurred a similar response, but to a lesser degree, with dacron being the more benign.

In addition, we noted that the cellular reaction to each suture was less in the muscular and elastic portion of the artery wall than that which was produced in the adventitial layer.

Technical properties. It was the opinion of



a b c

FIG. 4. A histologic section of an artery anastomosis of 27 days' duration. Fibrosis is most marked about silk, a, and considerably less in the artery wall when nylon, b, and principally dacron, c, was used. Note increased number of mononuclear cells in, a, and, b, and their relative absence in, c.

the authors who took part in this experiment that nylon arterial suture was the most manageable of the three suture materials when employed for arterial anastomoses of arteries 5 millimeters or less in their inside diameter. The reasons for this statement are as follows: first, less difficulty was encountered in inserting the individual nylon suture, especially in relation to the bothersome catching of residual adventitia. This problem was clarified by Shumacker and his associates who showed that complete and scrupulous removal of adventitia prior to the insertion of a suture in small arteries is required to insure their patency. However, we found that nylon permitted less of this tissue to be removed without endangering the integrity of the anastomosis. Second, less suture material appeared exposed to the flow of blood when nylon was used. As has been stated, the presence of suture material protruding into the lumen of the artery was most marked when dacron was employed. Third, nylon and dacron did not present the absorptive qualities of silk since blood and tissue juice did not alter their pliability. The stiffness which silk manifests when blood dries on its surface, as well as its tendency to adhere to adjacent skin towels and tissue, was seldom encountered with nylon. Dacron also showed this desirable feature.

Nevertheless, nylon presented certain disadvantages as an arterial suture. Foremost was the difficulty of securing a proper knot by conventional knot-tying methods. A springing apart of a square knot was frequently observed with nylon and to a lesser degree with dacron. As a result, we employed double square knots or a surgeon's knot with 3 extra loops and left rather long tails on the ends of the suture after they were cut. In no instance did a knot become untied. The possibility nevertheless appeared to be ever present.

DISCUSSION

Deterling and Dettinger and their associates and Howes have described qualities desirable for suture material. In a general fashion, high tensile strength, limited tissue response, noncarcinogenic properties, and ease of manageability are some of the most desirable properties of suture material, even more so when employed in vascular surgery. Needless to say, the results of our experiments confirm what has already been known, that fine braided silk is a satisfactory arterial suture. Recent advances in the field of plastics suggest that such products as nylon or dacron may be superior to silk because they possess greater tensile strength and produce less tissue reaction. This latter observation was confirmed in our study, although the exact role that these two factors play in determining the function of an artery

anastomosis is difficult to determine; for in each case, the primary purpose of the three suture materials studied (silk, nylon, and dacron) was obtained, which was approximation of tissue. This latter statement does not indicate that we are not concerned with tissue reactivity or tensile strength as desirable qualities of an arterial suture, but suggests that these factors may be compromised in selecting arterial suture material. Our study suggests that surface exposure of the suture to the flow of blood is a most important factor of arterial suture material in determining the patency of a small artery anastomosis. Of the three suture materials, nylon appeared to present less surface exposure to the flow of blood, and therefore the number of patent anastomoses was significantly greater when compared with dacron since the latter suture appeared to project more prominently into the lumen of the artery. This phenomenon was present when silk was employed but to a lesser degree than dacron and a greater degree than nylon.

As Dettinger and Bowers have stated in a recent paper directed to this problem, "all sutures now employed are compromises of the several requirements an ideal suture should possess." Nylon and dacron are not exceptions, for in our study the difficulty encountered in properly securing the knots, particularly with nylon, left much to be desired. Although we circumvented this problem by employing double square knots and adding additional loops to a surgeon's knot, in no instance did we encounter a knot which unwound or yielded in our in vivo experiments when this precaution was taken. Nevertheless we were always aware of the potential danger that existed. Additionally nylon appeared to be the most technically manageable of the three sutures for such small artery surgery, a factor which should cause less trauma to tissue. At present, the ideal suture material has yet to be discovered. However, under the terms of our experiment No. 5-0 nylon appeared to be more adaptable to small artery surgery, and since compromises have to be made, our studies suggest that it fulfills most of the requirements necessary for insuring approximation of a transected small artery and its functional integrity.

SUMMARY AND CONCLUSION

1. The result of an experimental study of three different arterial suture materials, silk, nylon, and dacron, has been presented.

2. This comparative study suggests that No. 5-0 braided nylon arterial suture has a number of desirable features for small artery anastomosis. This fact was principally shown by easy manageability and less exposure to blood flow when an end-to-end anastomosis was performed.

3. Furthermore, dacron and nylon were found to be superior to silk principally with respect to their greater durability and limited tissue response. However, the difficulty encountered in securing the former suture materials by conventional knot-tying method suggests that there is still no ideal suture, and in many instances compromises have to be made in selecting the material most suitable for the problem at hand.

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MESONEPHRIC CARCINOMAS OF THE OVARY

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SINCE SCHILLER'S original paper on mesonephroma of the ovary, considerable controversy has arisen concerning this tumor. It has varied from complete rejection of Schiller's concept to wholesale acceptance, with all grades of partial to complete skepticism in between.

The attitude of uncertainty about mesonephric tumors of the ovary is all the more surprising, since neoplasms of mesonephric origin appear to be readily accepted in other portions of the female genital tract, where the presence of Gärtner's duct may embryologically be sought. Thus, in 1954, Novak, Woodruff, and Novak studied 13 female genital tumors which they believed to be of mesonephric origin. Two were in the broad ligament, 3 were in the cervix, and 8 in the vagina. In comparing these tumors to Schiller's material, the authors affirmed the mesonephric origin of Schiller's ovarian lesions, despite the previous skepticism of the senior author. In addition the authors believed that these tumors were closely related histogenetically to clear cell or hypernephroid carcinoma of the ovary. The latter entity was described by Saphir and Lackner who pointed out the close resemblance to renal clear cell tumors, and also suggested the mesonephron as the probable source of origin.

Teilum, in the same year, also discussed the histogenesis and classification of mesonephric tumors of the female and male genital system. He described 14 malignant tumors in the vagina, ovary, cervix, parametrium, and corpus uteri, and 2 in the epididymis, testis, and spermatic cord. He compared them to the so-called benign mesotheliomas of similar areas and concluded that the latter tumors were merely the benign counterpart of the former. This is a controversial matter and will not be further discussed in this article.

Isolated reports of vaginal carcinomas of mesonephric origin have also appeared in the literature. In a recent article, Barbosa referred to the vaginal gland remnants (müllerian) as the probable source of the carcinoma. From the illustrations, however, it appears to us that the tumor was of mesonephric origin.

In a most recent paper, Studdiford has suggested a helpful classification of all adenomatous lesions of the vagina. He subdivides them into benign and malignant tumors. The latter are then further subdivided into those of mesonephric, and those of müllerian origin. The author describes 3 cases of the former, and 1 of the latter, with the conclusion that adenocarcinoma of the vagina comprises less than 10 per cent of all instances of primary vaginal tumors.

Finally, Stowe reported 6 cases of mesonephroma of the ovary with emphasis on their genesis. These cases showed both the features of the Schiller tumor and clear cell carcinoma. It was the author's idea that these tumors might take their origin from the tissues of the urogenital ridge in a stage less differentiated than the formative stage of the mesonephros, and the name of "urogenital mesoblastoma" was suggested by him as a descriptive term for the neoplasms in question.

During the last 7 years, we have had an opportunity to study 9 malignant ovarian tumors, believed to be of mesonephric origin. Four of the ovarian growths demonstrated definite areas of clear cell carcinoma which well resembled renal hypernephroid tumors.

From the Laboratory of Surgical Pathology and the Department of Gynecology, Medical College of Virginia, Richmond, Virginia.

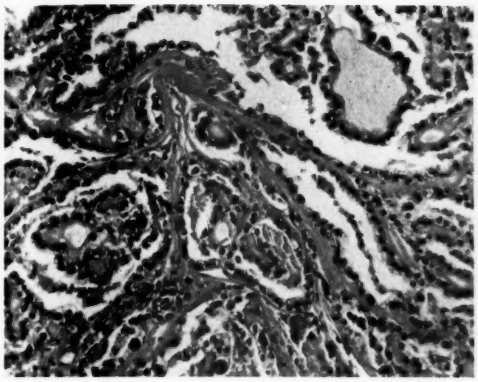

FIG. 1. Case 1. Cysts and tubules lined by vacuolated epithelium.

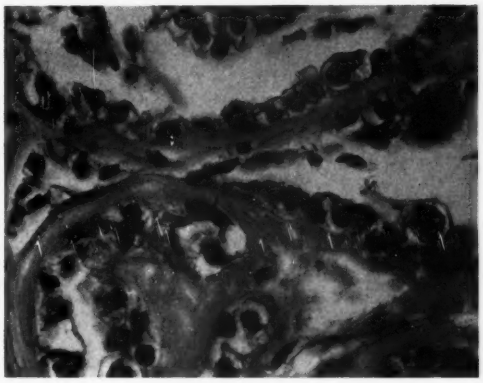

FIG. 2. Case 1. High power view of Figure 1. Note many hobnailed nuclei and vacuolated cytoplasm.

REPORT OF CASES

CASE 1. E. P., a 52 year old white woman, was admitted to the Medical College of Virginia Hospital on January 7, 1951 with a diagnosis of uterine myomas. These were discovered a few weeks prior to admission when the patient complained of a heavy feeling in the abdomen. She had had 4 previous hospital admissions for cystic mastitis, serous pleurisy, and cystic disease of the lungs. The menses had ceased 1 year prior to admission. On physical examination the uterus was thought to be enlarged to 1 inch above the umbilicus, with the greatest projection on the left side. The left lower extremity was edematous and tense, with the skin somewhat cyanotic. An exploratory operation was performed on the ninth hospital day. At laparotomy, a large, cystic structure was found to arise out of the pelvis. It was adherent to the left lateral pelvic wall, the broad ligament, and the sigmoid. The uterus was small and contained 2 walnut-sized, pedunculated tumors on the posterior surface. The tubes appeared normal and the right ovary appeared atrophic. In dissecting the cyst free from the surrounding structures, it was inadvertently entered. Following expulsion of a large quantity of thin, grayish-cloudy fluid, the cyst wall collapsed. After considerable difficulty, and following blunt and sharp dissection, the left adnexal organs were removed. A total hysterectomy with removal of right adnexa was also accomplished. The administration of roentgen therapy was started 1 week subsequently, a total of 12,000 roentgens to 8 pelvic and abdominal portals being given. She expired at home in September 1951. No autopsy was performed; nevertheless, the patient was presumed to have died of her tumor.

On pathologic examination the specimen consisted of a total uterus with right adnexa attached. The left adnexa were submitted separately. The latter consisted of a fallopian tube and attached cystic mass which was received in the collapsed state. It was approximately 16 by 12 centimeters in diameter. The outer surface of the cyst was smooth, glistening, and hemorrhagic. The inner surface was covered with numerous nodular excrescences that varied in size and shape. The cyst wall was 1 to 7 millimeters in thickness. Both fallopian tubes and right ovary had a natural appearance. The uterus was of normal size and showed the 2 subserous tumors as noted in the operative findings.

The cystic structure consisted of an ovary largely replaced by a papillary and cystic neoplasm. There were many tubules and irregular cavities lined by columnar epithelium containing bizarre nuclei (Fig. 1). In addition, papillary stalks covered by similar epithelial cells were seen. The epithelial cells of the tubules often contained clear cytoplasm, and many hobnailed nuclei were seen (Fig. 2). Stains for mucin and glycogen were positive. The uterine tumors were leiomyomas, and the other organs removed were normal.

The diagnosis of the condition of this patient was mesonephric carcinoma of left ovary and leiomyomas of the uterus.

CASE 2. A. S., a 47 year old colored woman, was admitted to St. Philip Hospital on June 28, 1951 for an abdominal mass known to have been present for about 4 years. This had gradually increased in size. Menses had ceased in January 1951, and no vaginal bleeding had occurred since that time. There were intermittent urinary frequency and nocturia without hematuria or dysuria. Physical examination revealed a soft uterus with a smoothly rounded mass in the dome of the uterus, about the size of a 5 months' pregnancy. The tentative diagnosis was leiomyoma of the uterus, and an exploratory operation was performed on the fifth hospital day. At laparotomy a large right ovarian mass, fused to the uterus which contained small myomas, was found. A total hyster-

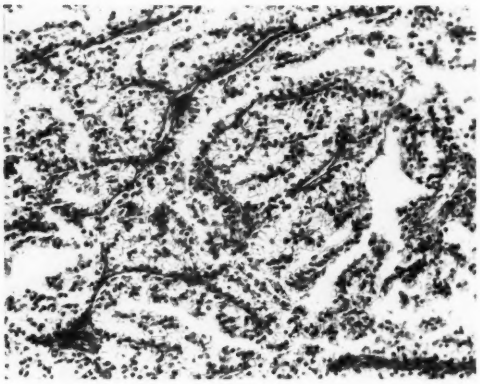

FIG. 3. Case 2. Typical hypernephroid carcinoma showing glands and papillary projections.

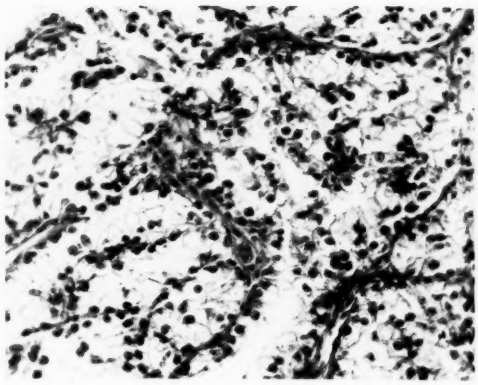

FIG. 4. Case 2. High power view of Figure 3 showing details of clear cells.

ectomy, bilateral salpingo-oophorectomy and appendectomy were accomplished. The patient was discharged 11 days later to be observed as an out-patient. X-ray therapy was started on July 7, 1951, and ultimately a total of 9,500 roentgens to 8 abdominal and pelvic portals was received. She was last seen in the Clinic on October 31, 1957 at which time there was no evidence of recurrence. There were, however, complaints of urinary frequency and nocturia, thought to be due to a low grade cystitis.

On pathologic examination, the specimen consisted of a total uterus with a fused, right adnexal mass. The mass had replaced the ovary, was 20 by 19 by 8 centimeters in size and showed a 17 centimeter fallopian tube stretched over one surface. There was a smooth, glistening, thin, white, uninterrupted capsule. The cut surface was nodular with many small cystic areas. The nodules were rubbery and pale tan. Yellowish, necrotic foci were intermingled with hemorrhagic areas. The tumor mass was adherent to the uterus which measured 10 by 4 by 3 centimeters and contained a 1 centimeter intramural myoma. Separately submitted were the left adnexa and appendix. These were grossly unremarkable.

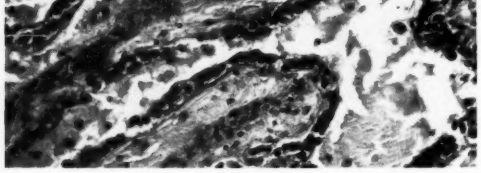

FIG. 5. Case 2. Glands with darker staining epithelium. Note dichotomous branching tubules.

Sections showed that the ovarian mass was a malignant glandular neoplasm. The tumor was composed of irregular dilated glands and tubules with numerous papillary projections (Fig. 3). These papillae were supported by thin, delicate vascular stalks. The cells were generally of the clear cell variety, so that a hypernephroid tumor was simulated (Fig. 4). The nuclei were large, rounded, and bizarre, often with prominent nucleoli. In other areas, the glands were smaller and lined by a darker staining epithelium, though clear cells were still apparent (Fig. 5). A mucicarmine stain was faintly positive, but a fat stain was not done. A portion of the tumor invaded adjacent myometrium by direct continuity. The other ovary was free of tumor. Both tubes were normal, and the appendix contained an obliterating neuroma. The endometrium was atrophic.

The diagnosis was mesonephric carcinoma of the right ovary with extension to the wall of the uterus, leiomyoma of the uterus, senile atrophy of the endometrium, and obliterating neuroma of the appendix.

CASE 3. M. J., a 50 year old white woman, entered the Medical College of Virginia Hospital on the service of Dr. Fred Walls on October 15, 1953, complaining of progressive increase in the size of her abdomen during the previous 2 months. The menopause had occurred 5 years previously, and there had been no menstrual bleeding since. Physical examination revealed a large mass arising out of the pelvis and extending halfway to the umbilicus. The mass was nontender and slightly irregular. A preoperative diagnosis of ovarian cyst was made, and an exploratory

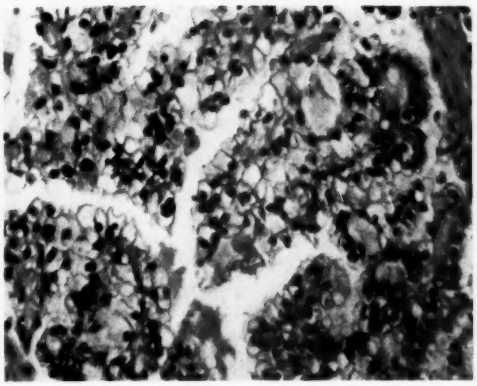

FIG. 6. Case 3. Papillary structures with extreme vacuolization of cytoplasm.

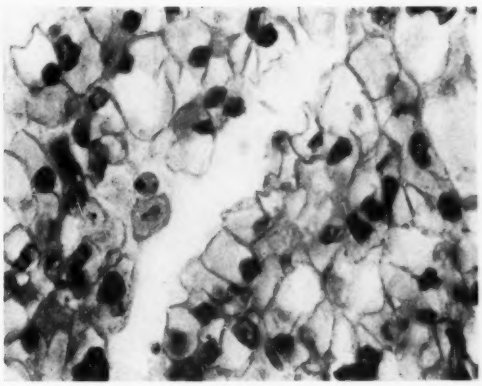

FIG. 7. Case 3. High power view of Figure 6 showing details of clear cells.

operation was performed on the first hospital day. A large cyst of the right ovary was found, and a right salpingo-oophorectomy only was done because the cyst was thought to be benign. Following the pathologic diagnosis of a malignant ovarian tumor, a total hysterectomy with left salpingo-oophorectomy was planned. This was accomplished 1 week later, and the patient left the hospital shortly thereafter in good condition. Roentgen therapy consisting of 12,000 roentgens to 8 pelvic and abdominal portals was given. She was last heard from January 20, 1958, at which time she was without symptoms. There was no evidence of recurrence.

On pathologic examination after the first operation, the specimen consisted of a partly collapsed cystic mass which contained a large amount of chocolate-brown thin fluid. In the collapsed state, the cyst was 11.5 centimeters in diameter. The external surface was smooth and shiny except in one large area, where fibrous adhesions and hemorrhages were seen. The cyst wall was thin and transparent. The inner surface revealed many papillary tumor masses, the largest 4 by 2.5 by 1.2 centimeters. Many were covered by brownish, necrotic debris and hemorrhage. The corresponding tube was free and had a natural appearance. Accompanying this specimen was a partially necrotic and calcified mass, 4.4 by 3 by 1 centimeter stated to be a pedunculated tumor removed from the internal surface of the uterus.

Microscopic examination of the cystic tumor showed a papillary and glandular carcinoma. The epithelial cells were atypical with abundant clear cytoplasm and small, dark-staining nuclei (Fig. 6). The appearance was that of a hypernephroid carcinoma of the renal type (Fig. 7). Best carmine stain for glycogen was distinctly positive, and small amounts of mucin could also be demonstrated. The tube was unremarkable. The separately submitted mass was a degenerated leiomyoma. The diagnosis was mesonephric carcinoma of right ovary and degenerated leiomyoma of uterus.

The specimen from the second operation consisted of a total uterus with adnexa attached. The uterus was pyriform and of normal size. It harbored 3 small intramural tumors. The serosal surface was covered with hemorrhagic areas. The fallopian tube had a natural appearance with a few serosal hemorrhages noted. The ovary was normal in size and contained a chocolate cyst which measured 1.6 centimeters in diameter.

At microscopic examination the uterine tumors were found to be leiomyomas. There was endometriosis on the surface of the uterus and tube. The ovarian cyst was also of endometrial origin.

The diagnosis in this instance was leiomyomas of the uterus and endometriosis of uterus, left fallopian tube, and ovary.

CASE 4. E. L., a 58 year old white woman, was admitted to the Hospital Division of the Medical College of Virginia on the service of Dr. Jacquelin Harrison on September 17, 1954, for the removal of a hard, solid ovarian mass, thought clinically to be an ovarian carcinoma. An exploratory operation was performed on the fourth hospital day, when a solid ovarian tumor on the right side was removed. The entire uterus and remaining adnexa were likewise excised. The patient's postoperative course was satisfactory and she was discharged 10 days later. She was last seen in September 1957, at which time there was no evidence of recurrence.

The pathologic specimen was received in two portions: first, the right ovarian neoplasm, and second, the entire uterus with tubes and left ovary attached. The ovarian tumor was largely solid with secondary cystic degeneration, and measured 16 by 12 by 7 centimeters. The uterus and cervix were small, the left ovary atrophic, and the fallopian tubes unremarkable.

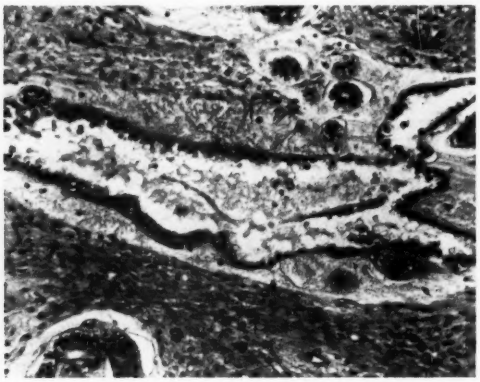

FIG. 8. Case 4. Glandular carcinoma with dichotomous tubules.

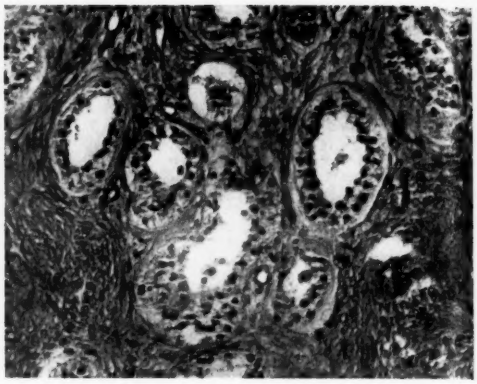

FIG. 9. Case 4. Area showing simple tubules lined by vacuolated cuboidal epithelium.

The ovarian tumor was found to be a carcinoma composed of tortuous tubules and glands lined by columnar and cuboidal epithelium. There were cystic as well as branching, dichotomous tubules (Fig. 8). The cytoplasm of the lining epithelium was generally vacuolated though typical "hypernephroid" areas were not seen (Fig. 9). Mitoses were scarce. A stain for mucin was positive. The diagnosis in this case was carcinoma (mesonephric type) of the right ovary, senile polyps of the endometrium, and chronic cervicitis.

CASE 5. I. A., a 46 year old white woman, was admitted to the Medical College of Virginia Hospital on the service of Dr. H. H. Ware on April 4, 1955, because of a cystic abdominal tumor extending up to the level of the umbilicus. This was first discovered 1 year ago, at which time she also had aphasia, numbness, and partial paralysis which lasted for several weeks. Her menstrual periods were regular until May 1954, and she had had no bleeding or vaginal discharge since that time until just prior to the present admission. The patient was operated upon the following day. A large cyst, about 20 centimeters in diameter, filled the lower abdomen and seemed to arise from the right ovary. It was ruptured in attempting removal. It was adherent to the intestines and omentum, but no visible implants were found. After removal, another cyst, about 8 centimeters in diameter, was discovered in the left ovary, which filled the posterior cul-de-sac and was stuck in the pelvis. This was also removed, following which a panhysterectomy and appendectomy were done. X-ray therapy was started 8 days after the operation, consisting of 6,000 roentgens through 8 abdominal and pelvic portals. She was discharged on April 22, 1955 to be observed as an out-patient. She died on January 27 the following year, presumably of a cerebral vascular accident. No autopsy was obtained.

The pathologic specimen consisted of bilateral ovarian cystic tumors which had previously been ruptured and a total uterus. Both cysts were thin-walled, multilocular structures, 15 and 7 centimeters in diameter respectively. The inner linings were studded with yellow, soft, pliable, papillary projections. The outer surfaces were essentially smooth, with a portion of distal fallopian tube attached to the larger cystic tumor. On sectioning, the papillary projections contained large areas of necrosis, with deposition of yellow pigment and hemorrhage. The uterus was of normal size and configuration. Several small endocervical polyps were seen. A fallopian tube was received separately and was unremarkable. The appendix was normal.

Sections through both ovaries showed a similar tumor. There were multiple complicated papillary structures and cystic glands (Fig. 10). The lining epithelium was bizarre, the cells being large and distinctly vacuolated (Fig. 11). "Peg" forms were a frequent finding where the lining epithelium was simple and not stratified. The vacuolated material stained positive for fat. Only scant amounts of mucicarminophilic material could be demonstrated. The uterus and fallopian tubes were unremarkable. The cervix showed nabothian cysts and several polyps. The diagnosis in this case was mesonephric carcinoma of the ovaries, nabothian cysts, and polyps of the cervix.

CASE 6. P. M., a 57 year old white female, was admitted to the Hospital Division of the Medical College of Virginia on the service of Dr. C. L. Coleman on April 27, 1955 complaining of vaginal bleeding and discharge during the past month. The climacteric had occurred 5 years previously. On physical examination a mass was palpable in the abdomen over the right lower quadrant and extending up to the umbilicus. Pelvic examination revealed a clean cervix and a grapefruit-sized, movable mass in the

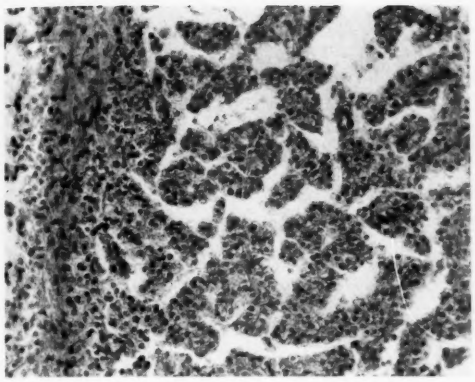

FIG. 10. Case 5. Multiple branching papillary structures are shown.

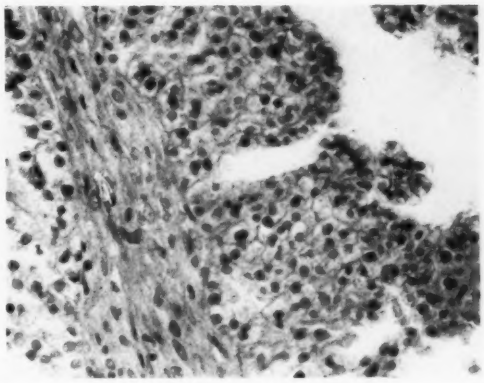

FIG. 11. Case 5. High power view of Figure 10 to show vacuolization of tumor cells.

right adnexal region. The patient was operated upon the following day. A left ovarian cyst was found which was removed and opened in the operating room. Because papillary growths were found, a total hysterectomy, bilateral salpingo-oophorectomy, and appendectomy were done. The patient was discharged 9 days later to be observed as an out-patient. She was last seen by her physician on January 11, 1958, at which time there was no evidence of recurrence.

At pathologic examination the specimen consisted of a total uterus, bilateral adnexa, appendix, and uterine curettings. The uterus measured 10 by 6 by 4 centimeters, and contained a small 1 centimeter endometrial polyp and a tiny intramural myoma. Both fallopian tubes were similar and had a natural appearance. The left ovary was replaced by a cystic structure, previously opened. It was approximately 10 centimeters in diameter and was filled with thick, dirty brown, semisolid material. The lining was pearly gray and glistening. Numerous papillary projections arose from the internal surface of the cyst. At one pole a firm mass 5 by 3 by 3 centimeters was present. This, when sectioned, showed a glistening yellow and pale tan appearance, with softened and hemorrhagic areas. The right ovary and appendix were unremarkable.

Sections through the left ovary showed a carcinoma with cystic and papillary areas as well as more solid regions where the tumor was principally of the glandular type. In the cystic areas the ovarian stroma was compressed, and from the surface there were papillary projections consisting of edematous and partly hyalinized stalks surmounted by tall, columnar epithelium with distinctly bizarre nuclei. Within the compressed ovarian stroma were tortuous, atypical glands lined by similar, tall, columnar epithelium. In many areas the cytoplasm was distinctly vacuolated, and in occasional areas the vacuolation was extreme so that hypernephroid carcinoma was well simulated (Fig. 12). The solid portion of the tumor showed more closely compacted glands, as well as cystic spaces lined by similar type neoplastic epithelium. Both scharlach R and mucicarmine stains were positive for fat and mucin respectively. The stained material resided in the cytoplasm of the tumor cells. The corresponding fallopian tube was uninvolved by tumor. The right adnexa showed no feature of interest. The endometrial curettings revealed hyperplastic glands, and the grossly described polyp was of the hyperplastic type. The diagnosis was mesonephric carcinoma of the left ovary, hyperplasia of the endometrium, polyp of the endometrium, leiomyoma of the uterus, squamous metaplasia, and nabothian cysts of cervix.

CASE 7. M. B., a 43 year old white woman, was admitted to the Hospital Division of the Medical College of Virginia on August 17, 1955. She complained of pain in her right side which was of 1 year's

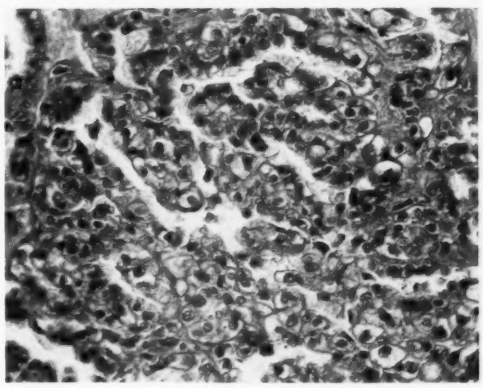

FIG. 12. Case 6. Area to show resemblance to hypernephroid carcinoma.

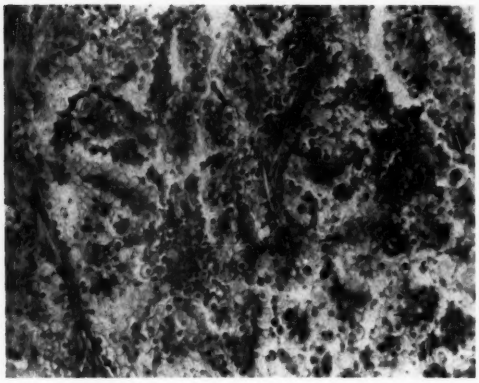

FIG. 13. Case 7. Papillary carcinoma typical of hypernephroid carcinoma.

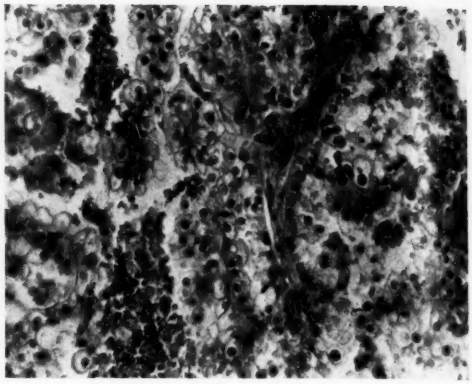

FIG. 15. Case 7. High power view of Figure 13 to show features of hypernephroid carcinoma.

duration. In addition, there were menorrhagia and dysmenorrhea which had begun 2 months prior to admission. A firm nodular mass was palpable in the right lower quadrant. A preoperative diagnosis of leiomyoma of the uterus or ovarian cyst was made, and an exploratory operation was performed on the third hospital day. At operation, multiple leiomyomas were found as well as a left ovarian cyst, the size of an orange. The cyst was ruptured, and its contents were spilled in the peritoneal cavity. A total hysterectomy, bilateral salpingo-oophorectomy, and appendectomy were done.

Following discharge from the hospital, the patient was reasonably well until January 1956, when she began to complain of nausea, vomiting, and abdominal distention. She was admitted to the hospital for the second time on February 9, 1956. Physical examination revealed a palpable mass in the left lower quadrant of the abdomen. On rectal examination, there were multiple small nodules thought to represent metastatic tumor. A barium enema showed almost complete obstruction in the rectosigmoid area. At operation, the abdominal mass proved to be omentum replaced by a solid carcinoma. The peritoneum and surfaces of the small and large bowel were studded with metastatic deposits. About 3 to 4 quarts of pale, yellow fluid were aspirated from the abdominal cavity, and the omentum was biopsied. The patient left the hospital against advice on February 25, after having received inadequate radiation therapy (a total of 3,500 roentgens delivered through 8 abdominal and pelvic portals). She died at home 1 month later. No autopsy was obtained.

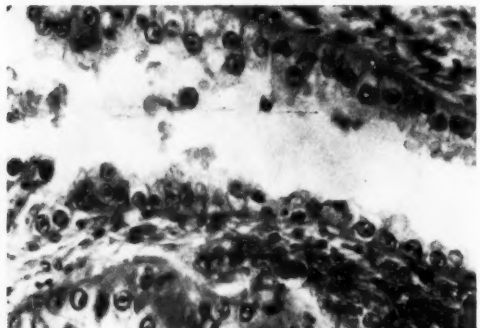

FIG. 14. Case 7. High power view to show detail of lining epithelium. Note vacuolated cytoplasm, variable height of epithelium, and prominent nucleoli.

The specimen from the first operation consisted of both tubes and ovaries received separately, an entire uterus distorted by multiple leiomyomas, and an appendix. The left ovary was cystic and collapsed. A pedunculated mass 3 by 2 centimeters in size projected from the internal surface of the cyst wall. Another smaller, yellow, hemorrhagic mass was firmly adherent to the inner surface. Studding the outer surface were several reddish-gray areas 1 to 4 millimeters in diameter. The right ovary and both fallopian tubes had a natural appearance. The appendix showed obliteration of the lumen in its distal half.

Sections through the left ovarian cyst showed that the masses projecting from the inner surface consisted of multiple dilated and cystic glands. Often these would have papillary projections, but sometimes they were lined by a simple columnar epithelium (Fig. 13). The epithelial cells were markedly bizarre, and the cytoplasm was generally vacuolated. A mucicarmine stain was definitely positive though only small amounts of mucin could be demonstrated. The nuclei were distorted and showed prominent nucleoli (Fig. 14). Many "peg" forms were seen. Often the

tumor cells would pile up toward the lumen so that small mounds capped by vacuolated material were seen. In the papillary areas, the stalks were thin and delicate, and the clear cell pattern was most distinct. In these regions the tumor resembled a renal hypernephroid carcinoma (Fig. 15). The right ovary was normal, and both fallopian tubes showed mild chronic inflammation. The uterus, in addition to the multiple leiomyomas, contained a hyperplastic endometrial polyp. The appendix showed an obliterating neuroma. The diagnosis was mesonephric carcinoma of the left ovary, leiomyomas of the uterus, polyp of the endometrium, bilateral chronic salpingitis, and obliterating neuroma of the appendix.

The specimen from the second operation consisted of an oval, soft, pale nodule measuring 5 by 2 by 2 millimeters removed from the greater omentum. It had a fleshy appearance with a few small flecks of hemorrhage on the surface.

On microscopic examination the fatty omentum was replaced entirely by metastatic neoplastic tissue. There were numerous papilla, and the tumor cells contained clear cytoplasm. It was apparent that this tumor was identical with that which was seen in the left ovary.

CASE 8. M. R., a 56 year old white woman, was admitted to Sheltering Arms Hospital on the service of Dr. R. A. Michaux on April 3, 1956, because of an abdominal mass which had been progressively enlarging during the past 3 years. On physical examination, the abdomen was distended with a ballotable mass, approximately 12 to 14 inches in diameter. It was freely movable and appeared to contain fluid. The patient was operated upon 2 days later and a huge left ovarian cyst was found. It almost filled the entire abdominal cavity, and was densely adherent to the sigmoid and greater omentum. The ovarian mass was first removed intact, and this was followed by a total hysterectomy and removal of the right adnexa. The patient was discharged in good condition on April 18, 1956 to be observed as an out-patient. She was last seen September 14, 1957 at which time there was no evidence of recurrence.

The specimen consisted of a complete uterus with attached right adnexa, a left ovarian tumor, and portions of omentum. The tumor was previously incised and measured approximately 18 by 15 by 9 centimeters. The serosal surface was smooth, although in several areas there was some adherent brown material suggesting old blood. The tumor, for the most part, appeared to be a large cyst. In the interior there was a big mass of soft, yellowish, gray, mucoid, and cystic tissue protruding into the lumen. The small cysts had a smooth, glistening lining, and no papillary projections were found. The uterus was covered by adhesions and showed 2 endometrial polyps and a tiny myoma. The right ovary was atrophic, and the left fallopian tube unremarkable. The omentum was not grossly unusual.

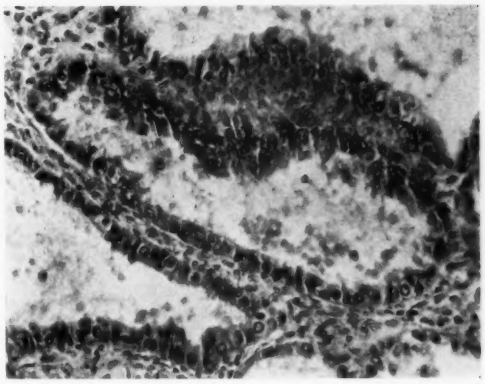

FIG. 16. Case 8. Compact neoplastic glands lined by epithelium variable in height and shape.

On microscopic examination, the ovarian tumor was essentially a cystic and glandular neoplasm. In some areas there were cystic glands lined by flattened simple epithelium with little anaplasia. These cysts merged with others having a more active epithelium. Other areas showed closely compacted glands which were markedly atypical with extremely bizarre lining cells. The latter were variable in shape and often showed "peg" forms (Fig. 16). Many of the dilated glands showed low papillary projections. The cytoplasm was granular and eosinophilic. Many of the tumor cells revealed mucin secretion. There were no definite clear cells. The uterus showed an atrophic endometrium and senile type polyps. Other findings were similar to those noted grossly. The diagnosis was mesonephric carcinoma of the left ovary, atrophy of the right ovary, senile polyps and atrophy of the endometrium, and leiomyoma of uterus.

CASE 9. B. T., a 26 year old colored woman, was admitted to St. Philip Hospital in September 5, 1956 with a diagnosis of pyelitis of pregnancy. She was approximately 8 months pregnant, and on physical examination showed only the enlarged uterus consistent with the duration of the pregnancy. The patient was discharged 2 days later, very much improved.

The second admission was on October 3, 1956 when the patient was in active labor. At this time it was thought that she had a right ovarian cyst. It was thought that following vaginal delivery, an exploratory laparotomy should be done. The patient shortly thereafter spontaneously delivered a stillborn male child, weighing 5 pounds. Immediately after delivery the patient complained of pain in the right upper quadrant and epigastrium. This increased in severity during the next 2 to 3 hours, and immediate laparotomy was advised. At operation 1,500 to 2,000 cubic centimeters of liquid and clotted blood were found in the peritoneal cavity. There was a right ovarian

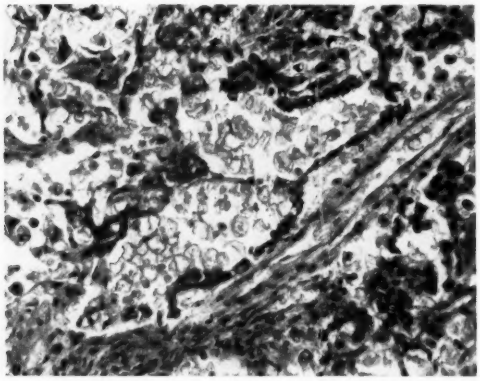

FIG. 17. Case 9. Extreme vacuolization of several neoplastic glands.

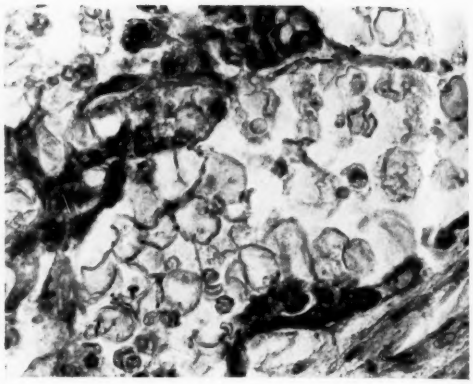

FIG. 18. Case 9. High power view of portion of Figure 17.

tumor which was both cystic and solid, partially ruptured and covered by adherent omentum. A complete removal of all pelvic organs was accomplished. The postoperative course was stormy, and was complicated by a wound dehiscence necessitating secondary closure of the abdominal incision on October 24, 1956. The patient was discharged on November 3, 1956, in fairly good condition.

The final admission was on December 27, 1956, because of abdominal swelling, abdominal pain, and constipation. There was a rather large left abdominal mass, and a left supraclavicular mass thought to be due to metastatic tumor. The latter was biopsied, and the peritoneal cavity was tapped. Approximately 4 liters of sanguineous fluid was removed which contained several pieces of free floating tissue. The patient gradually went into shock and expired on January 11, 1957. Permission for autopsy was not obtained in this instance.

The specimen from the first operation consisted of a postpartum uterus with left adnexa attached and a separately submitted right ovarian tumor mass and corresponding fallopian tube. The ovarian mass measured 29 by 20 by 11 centimeters and was firm in consistency with small cystic areas. The surface was smooth and glistening in some areas, and ragged and friable in others. The cystic areas were dark blue and purple, and the solid areas were pinkish-tan and yellow. The attached fallopian tube had a natural appearance. The tumor on cut section showed a mucoid surface, and granular, friable tissue. The postpartum uterus and attached adnexa had no unusual features.

On microscopic examination the right ovary was seen to be replaced by a highly anaplastic neoplasm. The tumor was composed of large irregular spaces filled with epithelial cells which appeared to be on a stalk. The cells were extremely bizarre and varied markedly in size and shape. The nuclei were large, and often showed monster forms. Multinucleated tumor cells were also present. A rather prominent feature in some areas was the presence of large vacuoles in the cytoplasm of the tumor cells (Figs. 17 and 18). These vacuoles would sometimes merge, leaving a network of solid cells in a vacuolated background. Distinct glands were seen in some areas, but for the most part the glandular pattern was obscured. The vacuolated material was positive for fat, and small amounts of glycogen also were present. No mucin could be demonstrated. The uterus showed retained secundines, and the other adnexal organs were essentially unremarkable.

The diagnosis was mesonephric carcinoma of right ovary, and postpartum uterus with retained secundines.

The biopsied left supraclavicular mass from the second operation showed a lymph node almost entirely replaced by metastatic tumor similar to that noted in the ovary. The vacuolated cells contained abundant glycogen material, but no mucicarminophilic material was found. The free floating tissue from the peritoneal cavity likewise consisted of metastatic tumor.

SUMMARY OF PATHOLOGIC FINDINGS

From the gross appearance of the ovarian tumors there was nothing especially characteristic that would permit a diagnosis prior to microscopic study. The tumors were generally cystic with solid areas. Papillary structures were a feature in some neoplasms. A few of the growths showed a mucoid substance exuding from the cut surface.

From the microscopic standpoint it was apparent that the picture varied from field

to field. Typical hypernephroid carcinoma was present in large areas with transitional changes to simple tubules lined by epithelial cells with little or no vacuolated cytoplasm. Some tubules showed dichotomous branching reminiscent of the developing mesonephron. Typical glomerulus-like structures were not seen. Tubules lined by simple cuboidal or columnar epithelium often exhibited "peg-cell" forms. The resemblance of tubules to the wolffian or mesonephric apparatus was noted in areas of some of the tumors.

No final conclusions could be reached with the use of special staining technique. Fat stains could only be done on a few cases, since wet tissue was no longer available in some of the older material. Whenever the fat stain was accomplished it was strongly positive, indicating that probably the vacuolization of the cytoplasm of the tumor cells was largely due to lipid substances. Mucinous material could be demonstrated in all cases except Case 9. This varied in amount, and hardly seemed to account for the extreme clarity of the cytoplasm when this was found. Nevertheless, it was of some importance to us, since normal wolffian duct remnants or cysts found incidentally in the female genital tract stain positively for mucin. A glycogen stain was attempted in only 2 cases, and this was positive in both instances.

COMMENT

The mesonephric ovarian carcinoma, such as described in this article, is not an uncommon tumor. During the same period of study, 66 cystic and solid ovarian carcinomas were submitted to the laboratory. The rare arrhenoblastomas, dysgerminomas, and granulosa cell tumors were excluded. The mesonephric type, therefore, comprised 13.6 per cent of the ovarian carcinomas—a figure to be reckoned with. Four of the tumors showed areas of pure hypernephroma. In 4 other cases there was distinct vacuolization of the cytoplasm so that it is conceivable that additional sections may have shown typical hypernephroid patterns.

Follow-up examinations in general have been too brief, but it is known that 3 and possibly 4 patients died of the tumors. Certainly it would appear that the diagnosis of ovarian carcinoma of the mesonephric type carries a guarded prognosis. The only valuable feature that we could find concerning the possible outcome of the individual patient was that of local extent of the tumor, and this seems also to be the case with most ovarian cancers. Thus an intact ovarian capsule, without adherence to adjacent structures, augured a more favorable prognosis.

It is obvious that proof of the mesonephric origin of ovarian neoplasms is not absolute, since in almost all cases the tumors are large, and the normal mesonephric apparatus is incorporated with the ovarian mass. Evidence of this histogenesis is therefore presumptive and based on the resemblance of ovarian mesonephromas to neoplasms in other portions of the female genital tract where Gärtner's duct can be implicated on anatomic grounds. When the ovarian tumors become indistinguishable from renal clear cell carcinomas, origin from mesonephric tubules seems the only logical conclusion. This gains additional support from the occasional rare finding of retroperitoneal hypernephroid carcinomas in the vicinity of the kidney, but distinctly outside its capsule.

CONCLUSIONS

1. Nine ovarian carcinomas of presumed mesonephric origin are reported.

2. These tumors are characterized by tubular structures which often resemble wolffian duct tubules. Branching dichotomous tubules may prove to be a prominent feature.

3. The tumor cells frequently show clear cytoplasm which in many instances stain positively for fat, mucin, and glycogen.

4. An exaggeration of the cytoplasmic vacuolization leads to a picture of hyper-

nephroid carcinoma which well resembles those clear cell carcinomas commonly found in the kidney. When vacuolization is extreme, lipid material appears to be the principal component in the cells.

5. These neoplasms are malignant and, when they arise in the ovary, presage a grave prognosis, should capsular invasion and adherence to adjacent structures be present.

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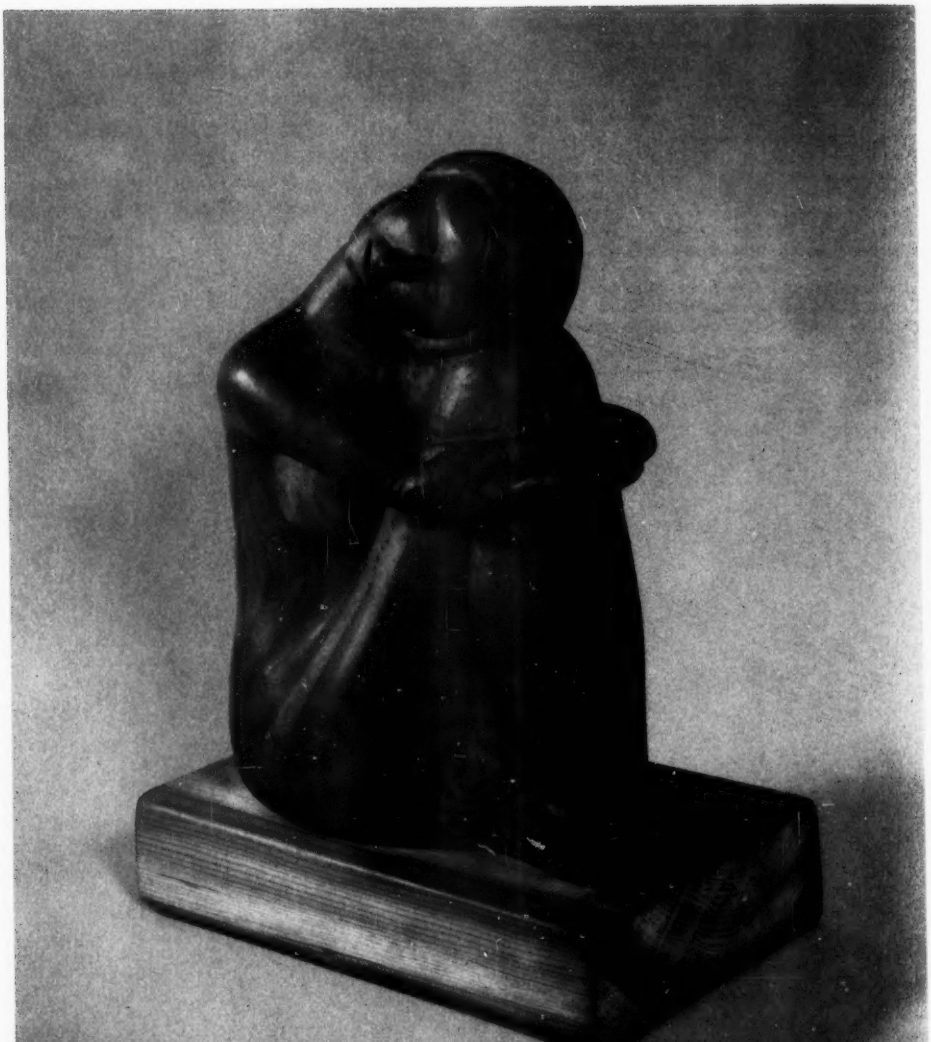

LEO ZIMMERMAN, M.D.

Reverie

EDITORIALS

INFLAMMATORY CARCINOMA OF THE BREAST

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THE TREATMENT of inflammatory carcinoma of the breast is controversial. Although most authorities believe that operation tends to spread the disease, some writers point out that their only good results have come following operation. When lesions are as uncommon as inflammatory carcinoma of the breast (about 2 per cent of all carcinoma of the breast) the answers to problems posed by them may be difficult to ascertain. Any one group of investigators sees so few examples of the disease that they cannot adequately test different methods of treatment—especially when they are biased toward a particular method. This explanation must account for the disparity of views about treatment.

Inflammatory carcinoma of the breast is a deadly disease and almost all patients who have it die within a short time. Charles Rogers,[1] when he was senior resident in surgery at the Hospital of the University of Pennsylvania, analyzed our experience with this lesion. I told Dr. Rogers when he began his study that I thought he would be impressed by the rapid progress of the disease when surgery was performed. To my surprise, after following up all 46 patients on whom we had made a diagnosis of primary inflammatory carcinoma of the breast, he found that our experience did not bear out the adverse effects of operation. In general, patients did badly no matter what treatment they had. Patients in our series responded a little better to operation than to other forms of treatment. One patient is now alive and free of disease 10 years after a radical mastectomy, whereas no patient lived more than 5 years without recurrence with any other form of therapy. Our series is small so that no claim can be made that the data prove significantly better results with operation than with nonoperative methods. It seems probable that the disease is so highly lethal that the best treatment will be hard to justify, by using the small series now available for analysis. The admonition that these patients should never be operated on is questionable, particularly in those with a localized form of the disease.

The literature on inflammatory carcinoma of the breast was studied with Dr. Stanley Schor, a statistician who has worked with our group on carcinoma of the breast for several years. He believes that the reported data are insufficient either to support or to reject the commonly held hypothesis that inflammatory carcinoma of the breast is inoperable and that surgical intervention accelerates the dissemination of the disease. Doctor Schor also pointed out that most of the articles in the English literature seemed biased toward the nonoperative treatment. He pointed out that a typical protocol of a patient undergoing nonoperative treatment reported in such an article would read: "The patient, a woman

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[1] ROGERS, C. S., and FITTS, W. T., Jr. Inflammatory carcinoma of the breast; critique of therapy. Surgery, 1956, 39: 367-370.

of 45 years, was admitted with an extensive inflammatory carcinoma of the left breast. Study disclosed no evidence of distant metastases. X-ray therapy greatly relieved her pain and discomfort and caused shrinkage of the inflammatory signs. She was able to return to work for a month and died comfortably *six months* after admission." The protocol describing the operative treatment would read: "The patient, aged 45 years, was admitted with an extensive inflammatory carcinoma of the left breast. No signs of distant spread were found. A radical mastectomy was performed. The lesion spread like wildfire, metastasized widely and produced severe pain. The patient could work for only a month and died miserably *six months* after operation." These protocols may be slightly exaggerated, but anyone who will take the trouble to read the literature on inflammatory carcinoma of the breast will agree, I think, that there has been considerable bias on each side of the treatment problem.

Some time ago I asked another statistician friend of mine to go over a paper, written by our group, on patients with nipple discharge. I was proud of what I thought was a rather large number of patients: 97. He brought me up short by saying: "How many patients in the world have nipple discharge and why don't you medical men over the country combine your studies of small groups of patients so that meaningful results may be obtained?" If several clinics would combine to study such infrequent lesions as inflammatory carcinoma of the breast and apply standard treatment, according to accepted procedures of random sampling, the answers to such problems as we have been discussing might soon be forthcoming. At present I think we should not teach that patients with inflammatory carcinoma of the breast must never be operated on. A few of these patients may be helped by operation, especially those with the localized form of the disease. Certainly the question has not been answered conclusively.

PHYSIOLOGY OF THE HUMAN PANCREAS

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TECHNICAL ADVANCES in surgery of the human pancreas have increased our knowledge of the physiology of this organ. Intubation of the pancreatic duct has permitted measurement and analysis of human pancreatic juice and roentgenographic visualization of the normal and diseased pancreas in the living. Observations on patients after total pancreatectomy have indicated indirectly some functions of the pancreas and have raised fascinating implications.

It has been determined that the human pancreas secretes from 1,500 to 4,000 cubic centimeters of juice in a 24 hour period. This contains digestive enzymes and a large amount of bicarbonate, equivalent in realizable terms, to from 30 to 60 five grain sodium bicarbonate tablets. The presence of such physiologically massive amounts of bicarbonate in the intestinal lumen creates an environment suitable for the optimal activity of the pancreatic enzymes, and possibly for the absorption of some substances such as fats. Attempts at replacement therapy in depancreatized patients by the use of potent pancreatin preparations, such as viokase, have not been completely successful because of lack of bicarbonate. Bicarbonate cannot reach the small intestine because of the neutralizing action of the gastric juice. Enteric-coated bicarbonate tablets, however, which resist release in the stomach, administered along with pancreatin will increase the absorption of fat.

The various enzymes in human pancreatic juice collected from pancreatic ducts are secreted in parallel concentration. In our experience these relative concentrations are not affected by diet or disease. Findings to the contrary in the literature appear to be due to errors resulting from instability of trypsin and lipase and relative changes which occur in vitro prior to analysis. Human juice contains minute amounts of active trypsin which, after collection and during storage, initiates rapid transformation of trypsinogen to trypsin. This, in turn, not only digests itself, but also the lipase.

Pancreatic juice secreted by the acutely inflamed pancreas contains large amounts of active trypsin in addition to trypsinogen. When acute inflammation subsides trypsin disappears. This active proteolytic enzyme may gain access to gland parenchyma through loss of semipermeability of duct epithelium which accompanies the acute inflammatory process. The juice is then no longer contained by the ducts and permeates the affected pancreatic tissue. This process may also explain a tendency for severe recurrences during the convalescence following acute pancreatitis.

Loss of semipermeability of duct epithelium in areas of acute inflammation can be demonstrated when radiopaque solutions are injected into the ducts for pancreatographic examination. When the acute episode subsides opacification no longer occurs, because duct epithelium regains its semipermeability. Loss of opacification is paralleled by disappearance of active trypsin from pancreatic juice.

The factors which permit reflux of bile into the duct of Wirsung must include the relative pressures in the bile and pancreatic ducts. Normally, the secretory pressure of the pancreas is between 300 and 400 millimeters of water and is equal to the secretory pressure of the liver. With increasing destruction of acinar tissue, however, the volume of pancreatic secretion is decreased and, more significantly, the initial response to food or secretin is delayed. This situation facilitates reflux of bile into the pancreas and may explain the progression and intensification characterizing the disease.

The pancreas has striking regenerative powers. Recurrent attacks of acute pancreatitis frequently cause increasing destruction of acinar tissue leading to reduced production of pancreatic juice and serious impairment of ability to digest food. It has been demonstrated by functional secretin tests and biopsy that following section of the sphincter of Oddi and proper dietary postoperative care, the pancreas will regenerate. Islet tissue of the pancreas often becomes destroyed in the process, and in one-fifth of advanced cases of pancreatitis an unusual form of diabetes ensues. It is crucial to distinguish this from diabetes mellitus, since this destruction of islets involves loss of glucagon-secreting alpha cells. Glucagon mobilizes sugar from body depots when the blood sugar drops to dangerous levels. Administration of insulin in such patients in doses as small as 10 units, if not covered by a meal, may result in hypoglycemic shock, cerebral injury, and even death. The same hazard exists after total pancreatectomy. As yet, no test to distinguish diabetes due to destruction of pancreatic tissue from diabetes mellitus has been devised. Regeneration of acinar tissue after operation, as evidenced by improvement in the response to secretin, is not accompanied by improvement of the diabetes. Apparently islet cells, once destroyed, cannot regenerate.

Healthy pancreas is not affected by the pancreatic enzymes it secretes, but if injured by inflammation, by impairment of its blood supply, or by poor nutrition it becomes the victim of its own secretion. Dietary alcohol and fats which do not affect the normal pancreas will often cause acute pancreatitis in patients who have had previous attacks. After resolution of inflammation and following regeneration to normal the pancreas no longer reacts deleteriously to these substances. The sensitivity of the injured pancreas to alcohol and fat is not understood, but appears to be due to some metabolic product which acts directly on the pancreatic cell. Pancreatic juice itself is not changed by the administration of alcohol or fat, and no operative procedure presently used in the treatment of pancreatitis will prevent this reaction. It follows that an operation such as sphincterotomy is only the first step in the treatment of pancreatitis. Rigid exclusion of alcohol and of more than a minimal amount of fat from the diet for a prolonged period is essential.

The rise in pancreatic enzymes in the blood during acute inflammation of the pancreas or following pancreatic duct obstruction has focused interest on the normal constant seepage of small quantities of enzymes into the blood. Is this phenomenon a fortuitous incident, or has the acinar part of the pancreas an endocrine as well as an exocrine function? There is considerable evidence that the circulation of pancreatic enzymes in the blood may act to increase the efficiency of the transport, deposition, and mobilization of fat and protein. Observations by Jordan and Grossman[1] on depancreatectomized patients indicate that while the absorption of fats and proteins is increased by the administration of viokase, the utilization of these absorbed substances is not complete. Further, the intravenous injection of lipase is followed by the disappearance of fat from lipemic blood,[2] suggesting that the presence of lipase helps in its deposition. Is it too far afield to postulate that the presence of pancreatic enzymes in the blood may be of help in the deposition, metabolism, and transport of fat, protein, and possibly carbohydrate? There is a difference between merely passable and optimal utilization of food. In the future it is possible that patients with injured or absent pancreas may best be maintained by replacing lost pancreatic juice with potent pancreatic extracts and enteric-coated bicarbonate, and promoting absorption of pancreatic enzymes into the blood through the sublingual route.

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THE SURGEON AT WORK

THE USE OF THE ASCENDING AND RIGHT HALF OF THE TRANSVERSE COLON IN ESOPHAGOPLASTY

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THE USE OF the ascending and right half of the transverse colon for replacement of the esophagus is becoming more widespread. It has been utilized for reconstruction in patients with carcinoma, tracheoesophageal fistula, and stricture. In certain centers it has become the preferred replacement when esophageal substitution or bypass is required. There are several features which establish the colon as a desirable substitute. These include adequate length, a good marginal blood supply, limited bulk, and a resistance to peptic digestion.

Esophagoplasty utilizing the ascending and right half of the transverse colon was initially and independently reported by Kelling and Vulliet in 1911. The procedure was rarely used until after World War II when it was reintroduced by Rudler and Lafargue and Lortat-Jacob. In 1953, Kergin reported a case of endothoracic transplantation. Sherman in this country has written extensively on the subject, and Mustard has reported on the procedure from Toronto. The present report includes our experience with 19 patients treated since August 1952 in whom the colon was passed through the mediastinum into the neck for the anastomosis. Some of these cases have been reported (7) previously.

The rationale for performing the esophagocolic anastomosis in the neck was pointed out in a previous study (6) which emphasized the importance of extensive longitudinal resection in the treatment of esophageal carcinoma. In that series, in almost 50 per cent of the cases it was demonstrated that an inadequate length of esophagus had been excised. In addition, if an anastomotic leak develops it is less serious and more easily managed in the neck than in the mediastinum.

The current definitive treatment of carcinoma of the esophagus at this institution consists of two stages, resection and reconstruction. The resection includes a total thoracic esophagectomy in continuity with mediastinal and upper abdominal lymph node dissection, proximal gastrectomy, distal pancreatectomy, and splenectomy (Fig. 1). The procedure will be described in detail in a subsequent article. Lesions of the upper thoracic esophagus may require laryngectomy. Nutrition is maintained by means of gastrostomy feedings between stages. When the patient has recovered sufficiently, alimentary continuity is re-established by utilizing the ascending and right half of the transverse colon.

We routinely obtain a barium enema before the second stage in an effort to avoid overlooking a silent lesion in the ascending and right half of the transverse colon. However, such radiologic study is not helpful in determining the length of colon available for transplantation, for it is the vascular pedicle which limits the amount of bowel which can be used. Bowel preparation is carried out as for removal of the ascending and right half of the transverse colon including the use of a low residue diet, cathartics, and antibiotics.

The right upper paramedian scar of the first

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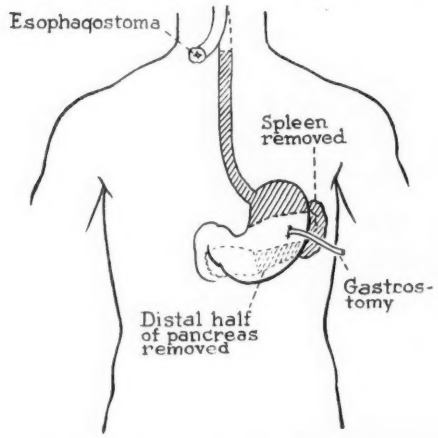

FIG. 1. Area of dissection of carcinoma of the esophagus. The patient is left with an esophagostoma and gastrostoma.

stage is excised and the abdomen explored. The ascending and right half of the transverse colon is mobilized and turned medially. The ileocolic vascular pattern is then visualized by transillumination. The length of the vascular pedicle depends upon several factors, the pattern of the right colic and ileocolic vessels being the most important. If these vessels are large it is unlikely that the middle colic vessels will nourish the entire ascending and right half of the transverse colon and terminal ileum. The caliber of the marginal vessels will govern their capacity to maintain viability, and the closer these vessels are to the bowel, the greater will be the length of available transplant. A deep V formed by the junction of the right colic and ileocolic vessels is ordinarily a favorable finding. When the mesocolon is cut along the vessels, the V widens to give greater length provided there are no restricting arcades originating from the parent vessels on the inner side of the V. An enlarged liver necessitates the development of a longer vascular pedicle than usual.

The right colic and ileocolic vessels, as well as the arcade along the ileum, are temporarily occluded with atraumatic clamps of the Potts type. It is important that the arteries and veins be clamped separately. If an attempt is made to occlude both vessels with 1 clamp the artery may prevent the total occlusion of the vein. It is our impression that the veins are of even more importance than the arteries. They are more friable and the least tension may interrupt their continuity rendering the transplant useless. A narrow strip of the mesentery should be left over the veins to help protect them. Furthermore, the veins occasionally appear to be functionally insufficient when the arterial supply seems adequate. In a few cases pulsation could be seen near the tip of the bowel and bright red blood appeared at the cut end. Yet, there was also dark blood and at least a portion of the bowel was dusky, the smaller veins appearing engorged. We believe that the veins are usually the limiting factor in determining the length of viable transplant.

While the vessels at the root of the mesocolon are temporarily clamped, the appendix is removed in routine fashion with inversion of the stump.

The ileum is divided 30 centimeters proximal to the ileocecal valve (Fig. 2); we prefer to have a viable section of ileum, as well as ascending and right half of the transverse colon, when possible. In some cases the cecum will not reach high into the neck and it is desirable to have a segment of ileum attached "to bridge the gap" (Fig. 3). If the segment of ileum is not required it may be resected (Fig. 4). If it is resected, one must be careful of the vessels which supply the tip of the cecum as they pass the ileocecal junction.

The omentum is dissected from that portion

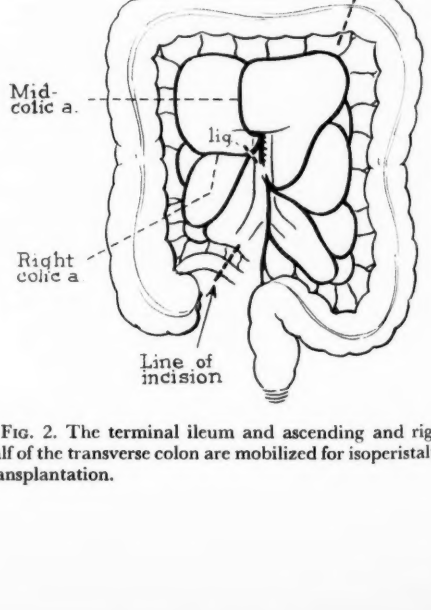

FIG. 2. The terminal ileum and ascending and right half of the transverse colon are mobilized for isoperistaltic transplantation.

of the transverse colon which is to be used in the transplant. The colon is divided to the left of the middle colic vessels. In 3 cases we have divided the marginal artery at this point with no deleterious effect. Intestinal continuity is re-established with a terminolateral ileocolostomy utilizing 2 layers of interrupted No. 0000 silk.

The isolated segment of bowel is then passed anterior or posterior to the stomach. When passed posteriorly it has the greatest possible length. Moreover, when the new esophagus is passed behind the stomach, there is no danger of the vascular pedicle of the transplant compressing the stomach and producing obstruction. These advantages are counterbalanced somewhat by the greater tendency to reflux when the colon is anastomosed to the posterior wall of the stomach. In most cases, the colon can be anastomosed to the anterior wall of the stomach from the posterior position.

Within the chest, the colon may be passed anteriorly or posteriorly. When it is passed through the posterior mediastinum, the cervical anastomosis can be completed behind the trachea so that the cervical esophagus is not displaced from its normal position. However, unless this is accomplished as a one stage procedure both abdominal and thoracic cavities must be re-entered at the second operation; by contrast, the colon may be passed through the anterior mediastinum without reopening the pleural space. Therefore, the route of choice with a two stage procedure is the anterior mediastinum. The colon may be passed with ease and we have not observed any symptoms referable to cardiac or pulmonary displacement. Technically, it is easier to pass the bowel through the superior thoracic aperture from the anterior position. However, if the larynx has been removed and a tracheostoma is present, the transplant must be passed around the trachea.

The distal end of the transplant is then anastomosed to the stomach. Usually this is most readily accomplished in the antral area, but the exact location of the anastomosis appears to be inconsequential. While the cologastric anastomosis is performed, a second surgical team begins the cervical phase. An oblique incision is made along the anterior edge of the sternocleidomastoid muscle to include the previously created esophagostoma. The strap muscles are divided as close as possible to the sternum, the pretracheal fascia is divided, and the anterior

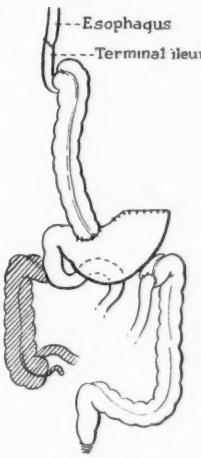

FIG. 3.

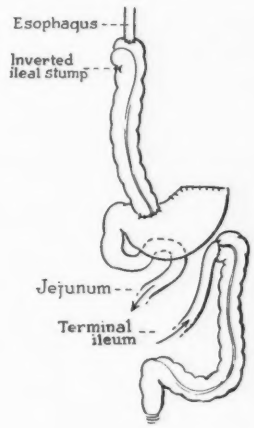

FIG. 4.

FIG. 3. Position of transplant. Ileum instead of cecum is anastomosed to esophagus.

FIG. 4. Final position of transplant.

mediastinum entered. With patience, a surprisingly large orifice can be created at the thoracic inlet. In 1 case we resected the inner portion of the clavicle, but we now consider this neither necessary nor desirable.

The development of the anterior mediastinal tunnel is begun at the abdominal end by cutting the diaphragmatic attachment to the sternum; the xiphoid may be excised if it seems desirable. This opening is gradually enlarged and the tunnel pushed cephalad until the fingers protrude from the superior aperture. This method is important because the dissection from below is usually superficial to the endothoracic fascia while the dissection from above is usually deep to the endothoracic fascia. If a clamp rather than the hand is passed retrosternally to complete the tunnel, the aperture in the endothoracic fascia may be quite small. When the bowel is ultimately delivered into the neck it may be constricted at this point. We observed a partial obstruction in the midportion of one such transplant and believe this to be the cause. In another patient, the constricting aperture was recognized at operation and the fascial opening was enlarged.

Often the tunnel can be fashioned without violating the mediastinal pleura but in several cases the pleura has been torn while reflecting it laterally.

TABLE I

Patient *Age, yrs.* *Level of tumor, cm.*	*Resected*	*X-ray therapy*	*Reconstructed*	*Status*
A.M. 62 23.5	9-23-54	Yes	3-8-55	Died 11-29-55. Autopsy revealed abscesses and fibrosis of the lungs; ? irradiation pneumonitis. There was a small residual focus of carcinoma in the wall of the cervical esophagus
C.W. 60 22	5-12-55	Yes	11-4-55	Died 5-30-56 of carcinomatosis
J.L. 63 25	7-17-55	Yes	1-17-56	Living 1-6-58 free of tumor
B.L. 44 33	9-13-56	No	10-30-56	Died 8-17-57. No autopsy. Liver enlarged, hard and nodular
R.P. 62 32	12-27-56	No	2-21-57	Died 2-23-57 from renal failure and pulmonary edema. No tumor on gross autopsy
K.C. 59 31	3-12-57	No	4-23-57	Died 4-30-57 of peritonitis and cerebral thrombosis. No tumor on gross autopsy
W.K. 59 16	5-21-57	No	2-18-58	Living 5-6-58 free of tumor
G.W. 67 17	9-10-57	No	11-12-57	Living 5-6-58 free of tumor

After continuity has been established between the abdomen and the neck through the anterior mediastinal tunnel, a heavy silk ligature is withdrawn from the neck through the tunnel into the abdomen and anchored to the ileal end of the transplant. By gentle traction on the ligature from above, while the transplant is inserted into the tunnel from below, the mediastinum is readily traversed and the ileum or cecum delivered into the neck. The bowel lies lateral to the recurrent laryngeal nerve and medial to the common carotid artery.

The esophagus is then anastomosed to bowel terminolaterally, making the lateral slit in the esophagus 2 centimeters long. This helps prevent subsequent stenosis at the suture line. If the anastomosis is to be made to ileum, the small bowel is also slit laterally to equalize the two circumferences. The anastomosis is fashioned with 2 layers of No. 0000 silk. Several sutures anchor the bowel to the surrounding fascia to prevent tension on the suture line. A Penrose drain is placed beneath the bowel at the level of the thoracic inlet and is brought out through the sternocleidomastoid muscle. An effort is made to see that the mesentery of the transplant does not overlay the trachea; otherwise if subsequent tracheostomy becomes desirable, the blood supply of the bowel may be compromised. No effort is made to approximate the divided strap muscles as this would tend to compress the bowel as it winds around the trachea. The platysma is approximated with catgut, and the skin is closed with interrupted silk.

In those cases in which the middle colic vessels are inadequate, some other method of reconstruction must be used. The descending and left half of the transverse colon is usually satisfactory if transplanted in an antiperistaltic direction. The passage of food through the transplant seems to depend solely upon gravity and the reverse peristalsis of the transplant is of little significance. In some cases the middle colic vessels are inadequate but the ileocolic vessels are large enough to maintain viability of the isolated ascending and right half of the transverse colon. In such a case, a transplant of the ascending and right half of the transverse colon in antiperistalsis is preferable to a transplant of the descending and left half of the transverse colon in antiperistalsis; an ileotransverse colostomy is preferable to an anastomosis of hepatic flexure to sigmoid colon. Rudler has even suggested that when the descending and left half of the transverse colon is used, it might be wiser to resect the ascending and right half of the transverse colon and do an ileosigmoidostomy.

In the immediate postoperative period a roent-

genogram of the chest is obtained to determine if a pneumothorax is present. Suction is applied to the gastrostomy tube until bowel sounds return. Gastrostomy feedings are then reinstituted. Nothing is given by mouth until the seventh postoperative day, at which time sips of water are cautiously administered. Oral feedings are gradually increased until a regular diet is possible. The gastrostomy tube is allowed to remain until it is certain that nutritional requirements can be satisfied by the oral route.

The present series consists of 17 such procedures performed at the Veterans Administration Research Hospital, the other 2 operations having been performed elsewhere. Resection was performed in 8 patients followed later by reconstruction; these are the patients in whom a cure was theoretically possible. The status of these patients is shown in Table I. An additional 9 patients have had palliative bypass procedures. Curative resection was not possible in these patients, and a bypass was done to permit them to swallow and to avoid the aspiration pneumonia which often follows obstruction of the esophagus. Most of them have received irradiation after the esophagoplasty, and these patients will be the subject of a subsequent article.

There have been 2 postoperative deaths. In 1 patient marked oliguria, pulmonary edema secondary to excessive intravenous fluid administration, and bronchopneumonia developed; he expired on the third postoperative day. In the second patient extensive peritonitis developed, the etiology of which was not apparent at autopsy. There was also a complete separation of the cervical anastomosis. The cervical esophagostoma was re-established, but he succumbed to overwhelming infection.

There was 1 instance of anastomotic leak in the neck of a patient who had an antiperistaltic bypass. There was a small intermittent cutaneous fistula in the neck of a patient whose area of anastomosis was included in the field of irradiation.

Those patients who had reconstructive surgery following resection swallow well; some swallow normally; the others have only a slight sensation of delay in the passage of food. There has usually been considerable subjective improvement as a result of the improvement in swallowing. One patient has had occasional regurgitation and belching following a sensation of fullness after eating. The cause of this is undetermined; results of barium studies have been negative. It is interesting to note that this patient has an esophagoileostomy and the ileocecal valve has not prevented regurgitation. In those patients who have died, there has been no evidence of peptic digestion of the colon.

SUMMARY

1. Esophagoplasty utilizing the ascending and right half of the transverse colon, with proximal anastomosis in the neck, is a satisfactory procedure for esophageal replacement or bypass.

2. Observations on 19 cases are presented.

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TRANSCECAL COLOSTOMY WITH NOTES ON TECHNIQUE AND MANAGEMENT

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ACUTE LARGE BOWEL OBSTRUCTION in most instances necessitates immediate operation. However, surgeons are not in agreement on how best to achieve decompression. Clinical and experimental observations have led us to believe that the emergency operation done for decompression must be based upon the operative findings: the location of the obstruction and the condition of the colon, rather than on a preconceived notion that any surgical procedure is exclusively best and routine. For example, transverse colostomy would not be done for obstruction in the ascending colon. Then again, in cases of carcinoma of the cecum and proximal colon, it may be best to do a definitive resection.

We have been interested in the mechanism of precipitation of acute obstruction (2). Unpublished data on carcinoma of the large bowel indicate that approximately 25 per cent of the patients with an obstructing large bowel tumor had previous episodes of obstruction which were relieved by enemas, or spontaneously. Clinical experience with these patients has demonstrated an interesting though paradoxic phenomenon. Decompression conservatively by judicious administration of small enemas or surgically by cecostomy or transverse colostomy relieves the obstruction so that the patient in a matter of hours may pass flatus or feces with relief of distention.

Organic obstruction, therefore in the presence of large bowel tumor must have occurred by some rapidly reversible mechanism. Whether the cause is prolapse of proximal mucous membrane into the lumen, foreign material plugging the orifice of the tumor, inflammation, or spasm is irrelevant; the more relevant point is that the obstruction may be relieved by the simple expedient of relief of distention quickly and simply.

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THE PROBLEM

The most frequent cause of colonic obstruction is carcinoma of the colon. When such an obstruction occurs and operation is performed, two pathologic states may be encountered with gradations between them: (1) the bowel may be paper-thin and tightly distended; or (2) the bowel may be more or less distended, but the thickening is due to mural hypertrophy.

The paper-thin bowel must be decompressed. By decompression we mean relief of gaseous distention. Relief is mandatory in this situation because the complications of this type of obstruction result from the distention, i.e., cecal perforation and cecal volvulus.

The thickened bowel, on the other hand, presents a somewhat different technical problem. In these instances, the colon is usually found to be hypertrophied, as well as distended, with or without significant cecal distention and may or may not demand emergency decompression.

The patient with a chronically obstructed bowel is one in whom transverse colostomy is technically less difficult to perform. The bowel is usually thickened, pliable, and softly distended. Acute obstruction, on the other hand, does not allow of mural thickening. Here, the cecal wall together with the proximal large colon is tremendously distended, paper-thin, and extremely difficult to handle. The transverse colon shares in this distention and is even more difficult to manipulate into a satisfactory loop colostomy. Attempts to construct a truly diverting colostomy are usually difficult. Because most of the patients with an acutely distended and obstructed bowel cannot tolerate extensive manipulation we have devised an efficient, safe type of colostomy, a transcecal colostomy, and have attempted to improve upon its management.

THE TRANSCECAL TUBE

Our attempts to render cecostomy more mechanically effective are based on previously

reported anatomic studies of the ileocecal valve and papilla (1, 3). In brief, we have shown that the cecum is a blind pouch lying caudal to the opening of the ileocecal papilla, that the ileocecal orifice directs the ileal stream cephalad. Thus, a tube which drains the lower blind end as well as the ascending colon should be more efficient than the usual de Pezzer or mushroom catheter which can only drain the cecum, and then effectively only if the patient is upright, that is, if the cecum is made dependent.

The transcecal tube is a mushroom catheter of the usual length with an extension which fits into the ascending colon and in some patients may even reach to the hepatic flexure (Fig. 1).

In order to compare the mechanical efficiency of the transcecal colostomy tube to the standard de Pezzer catheter, experimental work on fresh cadavers was carried out as follows: a large rectal tube, the same caliber as the draining tube in question, was placed in the terminal ileum with its tip directed to the ileocecal valve. The de Pezzer or the transcecal tube was fixed into the cecum by a double inverting purse-string suture. The cecum was not exteriorized or fixed to the parietal peritoneum. The rectal tube was then perfused with water at varying drop rates, and the volume of drainage collected from the drainage tube was compared to the volume of input into the rectal tube. The 2 drainage tubes were then compared for volumes of output. The de Pezzer catheter removed 70 per cent of the delivered ileal fluid while the transcecal tube under the same circumstances removed 89 per cent of the delivered ileal perfusate. These were average values for 14 cadavers.

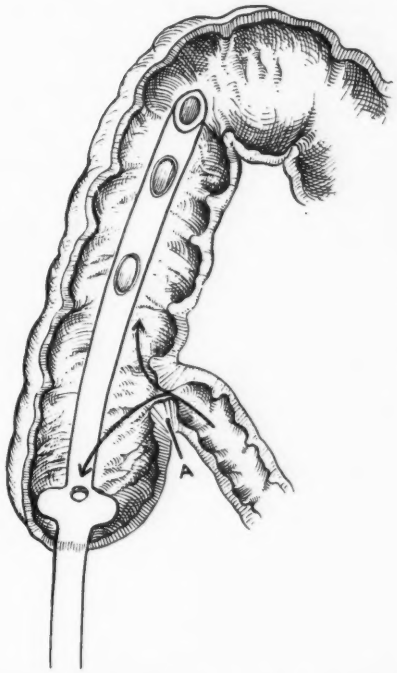

FIG. 1. The transcecal tube in place in the ascending colon. The ileocecocolic papilla which directs the ileal stream cephalad into the ascending colon is shown at *A*.

TECHNIQUE OF TRANSCECAL COLOSTOMY

The performance of a cecostomy as an emergency measure in cases of acute obstruction is as follows: a McBurney incision is made through which the cecum is located. It is not manipulated but walled off with large moist sponges. The caput coli is perforated by a trocar or large bore needle and rapidly decompressed. This maneuver removes most of the gas and fecal content and produces a collapsed and easily handled cecal wall. A No. 0 chromic catgut suture is placed as a purse-string through and through the cecal wall around the trocar. The trocar is removed rapidly and the tube is introduced into the colon. This purse-string suture is then tightened around the shaft of the tube. Fecal spillage is minimal and adequately cared for by the preliminary walling off of the cecum. The shaft of the tube is advanced a centimeter or so after a seromuscular purse-string suture has been placed around the tube. The second purse-string suture is then tied to assure a serosa-lined fistula when the tube is removed. The wound is closed loosely about the tube, and the cecum is not sutured to any of the layers of the abdominal wall but is allowed to lie against the parietal peritoneum, held in this position by the weight of the tube. We wish to emphasize that a cecostomy done for emergency decompression should include immediate opening of the bowel and intubation for effective drainage.

The postoperative management is important. The cecum must be dependent. This is achieved by maintaining the patient in Fowler's position. Early ambulation is also helpful. The drainage device must be primed at least twice daily. For this procedure we use 6 to 8 ounces of physiologic saline. Once the bowel is decompressed,

provision must be made for the entry of air, as well as fluid, because suction alone (siphonage) will collapse the walls of the bowel around the tube. Then adding 1 to 2 ounces of air to the fluid irrigation will usually provoke a copious outpouring of ileocecal discharge. With such management, patients have been prepared for definitive surgery in 10 to 14 days.

The transcecal colostomy tube has been used satisfactorily in 8 patients. The mortality rate for cecostomy has been variously reported to range from 3 to 45 per cent. In 294 cases of obstructed colon due to carcinoma, regardless of the method of surgical decompression, we found that there was no significant difference in mortality between cecostomy and transverse colostomy (over-all mortality rate 11 per cent; operative mortality rate 5 per cent). We could conclude from our review that, generally, mortality was due to factors other than the method of surgical decompression.

SUMMARY

Acute large bowel obstruction due to carcinoma can be effectively and safely managed by a properly performed and well managed cecostomy. Further, the use of a transcecal colostomy tube which we have described will further increase the efficiency of the cecostomy.

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THE SURGICAL PROBLEM IN REPLACEMENT AORTIC AND ARTERIAL GRAFTS

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WHILE THERE HAVE BEEN many reports recently on the successful use of analogous, homologous, and prosthetic grafts for the replacement of injured or diseased aortas and arteries, the techniques of such operations are not new. Years ago, Goyanes, Leriche, Delbet, Dos Santos, and more recently, Bazy and Kunlin, all presented indications and methods of inserting such grafts. In 1902, Carrel's vascular suture technique won a Nobel prize. Horsley's text, in 1915, described the operative measures now being used. Infection, clotting, hemorrhage, and technical problems were the causes of most replacement failures. Antibiotics and the anticoagulant drugs and blood vessel homograft banks, as well as the development of more satisfactory prosthetic replacements, have permitted many more of the grafts to be successful. The technique itself has changed but little.

Many surgeons believe that they are technically qualified to perform arterial graft surgery. Such operations require on the part of the surgeon not only the ability to perform the blood vessel anastomosis but also the acceptance of a great responsibility in judgment. He must have sufficient experience to determine not only whether he can perform the vessel graft but, more important, whether he should do so in the particular patient, even if he is technically capable. This decision is the most important part of the operation as once it is made it is irrevocable. If the surgeon's judgment is wrong it may cost the patient his life or, perhaps, only his limb. In the present article, the problems involved in making this determination are presented, and the experience of one more clinic in the field of arterial grafts is added to the extensive literature accumulating on the subject. The optimistic reports in the literature of the successes of bold vascular graft surgery may mislead some surgeons. They may believe that this type of surgery is simple and usually successful. If our experiences are typical, replacement vessel grafts are neither technically simple nor, by any means, routinely successful.

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PREVIOUS WORK

Our experience with blood vessel anastomoses began with the treatment of aortic aneurysms in the period from 1931 to 1935 in conjunction with Babcock (10, 12). Thereafter, between 1935 and 1941, six analogous vein grafts for aneurysm were placed successfully (10). Our work in artery replacement, after the war years, was aided by a grant from the United States Navy[1] to study collateral circulation and to try to dissolve or replace major vessel obstructions.

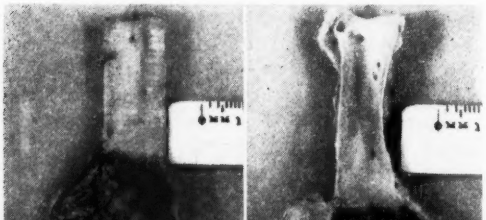
Aortograms and arteriograms usually show which obstructions require grafts. Analogous artery grafts rarely can be used as they sacrifice the donor artery and thus destroy the blood supply to the part by the artery used as a replacement. Venous grafts often dilate or thrombose. In emergencies, however, they may be lifesaving. Efforts to use other substances in the body of an analogous nature, such as skin, bowel, or fascia, have not been successful. The use of peritoneum lined fascia is being studied now. The prosthetic replacements will be discussed in more detail.

ANIMAL EXPERIMENTS

We believe it is of interest to report on our graft experiments in animals. First, analogous grafts were used. Skin, bowel, and fascia were used as grafts to replace a segment of the dog's aorta. Of 124 dogs, in which aortic grafts were placed, 90 dogs survived the operation for more than 1 week.

Analogous grafts. Grafts of skin (Fig. 1a) were prepared both as full thickness and also as split grafts by using an electric dermatome at 15/1000 of an inch to raise the graft. These replacements were sewed to form a tube the size of the dog's

[1]Grant No. NR 102-025.



a b

FIG. 1. a, Dog 19. Aortic graft made of dog's own skin with thrombosis and rupture. b, Dog 18. Aortic graft made of dog's bowel with thrombosis and aneurysm.

aorta. Sixteen grafts were so placed; 10 dogs survived the operation but all of these dogs died subsequently of hemorrhage or thrombosis, or both. Of these 10, the longest survival was 52 days.

A loop of bowel with the dog's mesenteric blood supply attached was then used as an aortic graft (Fig. 1b). In 14 experiments, the serosa was folded on itself so that the graft tube would be lined with serosa. All of these bowel loops used as grafts failed; the longest survival was 14 days.

Fascia was then used as a graft. This, alone, as a type of graft has failed. The fascia, lined with peritoneum (posterior layer of the rectus), is sewed over a tube and left in the abdominal wall for 2 weeks. The possibilities of this method are being studied at present.

Prosthetic grafts. Eighteen grafts were made of ivalon sponge and inserted in the aortas of dogs (Fig. 2a). All but 6 of these eventually failed. One dog lived 7 months after the aorta was replaced by an ivalon graft. Another dog which survived 9 months was reoperated upon in error as an unoperated upon dog for replacement of the aorta by a graft. At the second operation, the ivalon graft was found to be completely occluded, although the dog's hind legs and tail were functioning normally because of action of the collateral vessels.

Twenty-seven crimped grafts of the nylon type introduced by Tapp and Edwards were placed in the dogs' aortas. Of these, 26 functioned satisfactorily for a time, but 10 failed, 3 because of massive hemorrhage and 7 because of thrombosis and occlusion. It was apparent that, of the grafts used, the best material for our work, prior to the introduction of crimped teflon, was the nylon of the Tapp-Edwards type (Fig. 2b).

Various other "cloth" substitutes such as dacron and vinyon N were used in the dog's aorta. There was more leaking through vinyon N than through dacron although the variation in weaves of these cloths resulted in different degrees of porosity and, therefore, bleeding.

Steel wire mesh was used as a donor graft in 4 dogs. This mesh did not make good graft material. It was difficult to sew and the blood flow clotted.

Crimped teflon, in our experience, is the best available material for grafts. Homografts were prepared in our artery bank from the aortas of dogs sacrificed to obtain blood for priming our extracorporeal circulation pump. These were sterilized with ethylene oxide and preserved as freeze dried grafts. These grafts were sutured end-to-end and end-to-side as bypass aortic grafts. Of 29 animals grafted, there were 20 long term survivors. These grafts work well if they are taken from the donor and cooled immediately and are inserted in a technically correct manner.

CONTRAINDICATIONS TO BLOOD VESSEL GRAFTS

The contraindications to the insertion of an arterial graft have not been sufficiently stressed. Vascular grafting can be successful only if the vessel's block is localized and there is an adequate aortic or arterial flow proximal and distal to that obstruction. These are fundamental limitations to the use of the blood vessel replacements in occlusive aortic arterial disease and should be obvious ones. Aneurysms pose a separate and a special problem. Contraindications to aortic or arterial grafts may be summarized as local and general in nature.

The local conditions are: (1) poor blood flow from the proximal artery; (2) inadequate distal vessels to carry away the blood to be supplied by the grafts; (3) other obstructions to the vessel distal to the site at which the placing of a graft is contemplated; (4) the proximal or distal end of the blood vessel of such a friable nature or so small as to make anastomosis technically impossible; (5) the presence of open or gangrenous lesions of the extremity. While the first two points

seem obvious, they need re-emphasis. If the blood flow from the proximal end is not adequate, and it cannot be improved by going higher up the vessel or by endarterectomy, no grafting procedure distally will improve the patient's circulation. Likewise, and as important in the surgeon's decision, if the vessels distal to the grafted point cannot carry away the blood that the graft will deliver, no replacement graft should be placed. The distal vessel, therefore, must be opened first to see if there is an adequate return blood flow. This must be done even if an aortogram or arteriogram indicates that there is an adequate runoff. Sometimes the flow depicted by roentgenograms is only a thin or ribbon-like opening in an otherwise obstructed distal vessel.

The general conditions which preclude grafting are: (1) old age, not only chronologically, but by the extent of artery disease; (2) advanced renal disease, especially in considering aortic replacements; (3) severe cardiac disease, particularly aortic valvular lesions; (4) most cases of cerebral vascular occlusion. All these general preclusions pertain to occlusive arterial disease but require individualization. In aneurysms, many of these contraindications will be waived as the risk of operation usually is less to the patient than that of no operation at all.

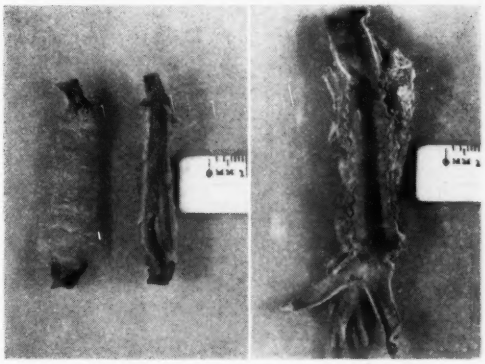
SELECTION OF PATIENTS

Patients with aneurysms, segmental occlusions due to arterial occlusive disease, trauma, or embolism are candidates for grafts.

Grafts are most often successfully placed in the younger age group, although patients of any age can have vessel grafts. The insertion of a graft in a patient over 70 years of age probably is contraindicated except as a lifesaving measure when rupture of an aneurysm in an otherwise healthy individual has occurred or is imminent. The apparent, as well as the actual, age should be considered.

AORTOGRAM AND ARTERIOGRAM

This test should be done in all patients with occlusive arterial disease. Some aneurysms, also, require the same test. A minute amount of dye should be injected intravenously to eliminate the possibility of allergy. For an aortogram, the dye is injected into the aorta through a translumbar approach. A femoral arteriogram can be seen at the same time by placing a second cassette below the groin or by a second dye injection.



a b

FIG. 2. a, Dog 21. Ivalon graft thrombosed. Dog lived 9 months. b, Dog 10. Crimped nylon type graft functioning 180 days after insertion.

Only local anesthesia is used for these intra-aortic or arterial tests. An anesthesiologist, however, as well as all equipment for intubation and the treatment for cardiac arrest is present because of the possible respiratory or cardiac failure due to allergy and shock. A forceful flow of bright arterial blood into the syringe during cardiac systole confirms the fact that the needle is in the major vessel to be injected. Thirty-five to 50 cubic centimeters of the dye (70 per cent urokon or hypaque gave best results) are then injected directly into the aorta or the artery as rapidly as possible with a 50 cubic centimeter syringe. The x-ray picture at $^4/_{10}$ of a second exposure is taken simultaneously with the injection. With this technique, the distal artery rarely has to be demonstrated by a separate femoral arteriogram.

SURGICAL SYMPATHECTOMY

In those patients in whom the peripheral circulation appears inadequate, a surgical sympathectomy is first performed to guard against occlusion of the smaller vessels should therapy for the major ones be impossible or unsuccessful.

SURGICAL TECHNIQUE FOR ABDOMINAL AORTIC GRAFT

All operations for aortic and iliac graft are performed under hypothermia anesthesia (84 to 90 degrees F.) to reduce the number of neurologic complications which follow shutting the circulation to the cord.

The abdomen is opened through a long left

rectus incision, paralleling the medial border of the aorta, extending from the ribs to the pubis. All intestinal loops are elevated, and the cecum and sigmoid are displaced contralaterally. The retroperitoneum is incised along the aorta from the ligament of Treitz distally. The bowel is excluded from the field by suturing the anterior and posterior peritoneum together. The aorta and the iliac and femoral arteries are mobilized. The distal arteries are opened to determine the adequacy of distal flow. If resection of the aorta is to be done, the type of graft to be used is selected. It may be necessary to free the sigmoid, spleen, and part of the pancreas to obtain sufficient operative exposure, and occasionally the incision has to be continued into the chest through the seventh interspace. The type of clamp to be placed on the aorta has been a subject of great concern to us. Various clamps on the aorta were tested in 12 dogs. When the aorta was obstructed for 30 minutes by a crushing type of clamp, thrombosis occurred in 1 out of 6 animals, after resection of the aorta, despite a technically correct anastomosis. Tapes, vaseline, rubber bands, catheters, and rubber tissue drains, also, may cause a similar thrombosis. The Glover or Potts rubber shod clamp is slowly applied to the proximal end of the aorta and is closed only until the blood flow ceases from the end of the divided vessel. The clamp is tied closed by using an umbilical tape. A modified DeBakey aneurysm clamp is often used to which a ratchet closure on the distal end of the clamp has been added.

For the aorta, a No. 3-0 or 4-0 running over-and-over suture is used on all vascular anastomoses except those performed in children. In the latter, the interrupted type of suture is used as the vessel is expected to grow. No. 4-0 or 5-0 silk sutures are used in the iliac and smaller arteries. In bifurcation grafts the lower end of the graft is anastomosed first, to reduce the time the blood flow to one leg is shut off, and, also, to shorten the time the collateral lumbar vessels must be occluded. If the aneurysm is adherent to the vena cava, a portion of the aneurysm wall may be left attached to this large vein to avoid damaging it during dissection. A heparin drip is inserted in the distal vessel until the anastomosis is completed. We advocate the use of a pump oxygenator distal to the graft for maintaining the oxygen supply and circulation to the renals, bowel, and leg vessels distally to the graft.

TECHNIQUE FOR RESECTION OF THE ARTERY DISTAL TO THE INGUINAL LIGAMENT

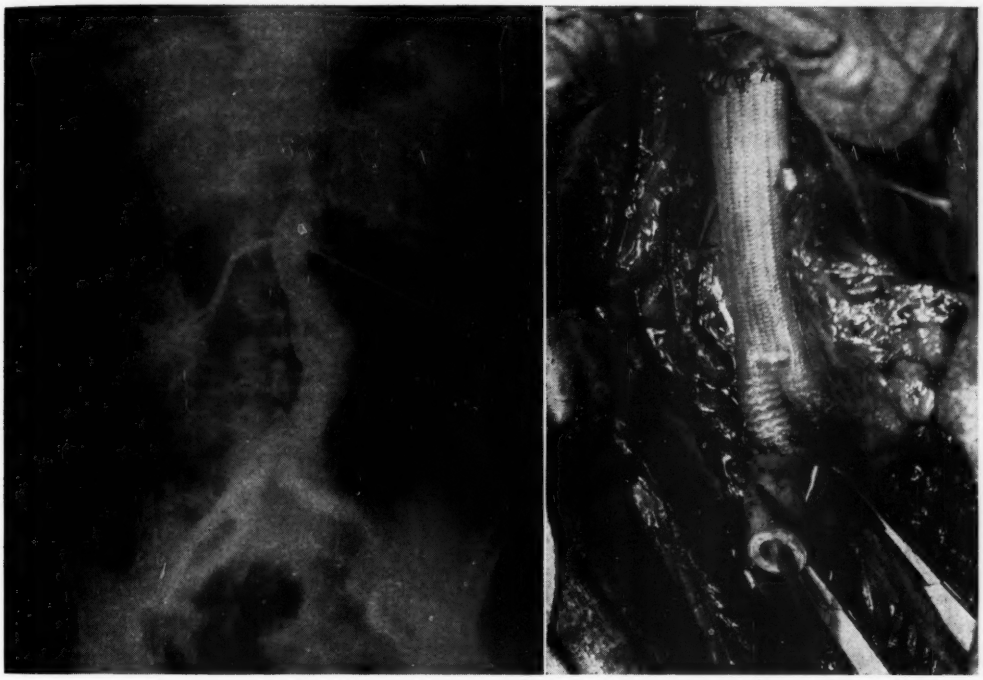
The femoral artery is widely exposed by an incision on the medial aspect of the left leg with the knee bent. A sandbag placed under the opposite hip helps to expose the popliteal and femoral areas at the same time. The sartorius muscle is the anatomic guide to the artery and it is dissected free so that the vessel can be approached from either side. Since the adductor muscle usually compresses the artery, it is freely divided at the adductor canal. The semiflexed knee helps to mobilize the distal vessels. The medial approach permits one to mobilize the popliteal artery as far as its bifurcation. If a good arterial flow is found proximal and distal to the block in the artery, an end-to-side anastomosis graft is performed around the blocked area. A mattress suture is inserted proximally and distally at either end of the anastomosis. A continuous suture is then inserted between the donor and recipient grafts. The clamps are then removed, the distal one first. The slight hemorrhage at the anastomosis and the graft interstices usually subsides with simple hand or gauze pressure. Occasionally, a mattress suture has to be placed at a leaking point.

Anticoagulants. The patient is maintained on heparin for 24 hours to keep the bleeding time above 12 minutes. Oral anticoagulants are begun at once and these replace heparin after 24 to 48 hours when the prothrombin time is prolonged beyond 20 seconds. The leg is maintained in a semiflexed position and gradually is straightened out. Weight bearing on this limb is allowed after 7 to 14 days, although the patient may be out of bed on crutches within 48 hours.

CLINICAL RESULTS WITH GRAFTS IN HUMAN BEINGS

Our clinical results are divided into two parts. From 1952 to June 1954, 30 vein grafts were used to replace or bypass occluded arteries in human beings. As of 1956, only 2 of these patients had venous bypasses which could be proved to be open and functioning. Eight other patients could not be traced. Two patients had lost their limbs postoperatively and 2 others had had amputations of limbs up to 1956. The other 16 patients considered their circulation sufficiently satisfactory for them to refuse to have recheck arteriograms.

From June 1952 to June 1957, 140 patients were operated upon in the hope of placing a



a b

FIG. 3. a, Aortogram showing aneurysm. b, Insertion of bifurcation graft for aneurysm with return of all distal pulses.

graft. Grafts were placed in 76 of these patients, 55 per cent. Of the other 64, arteriotomies—or intimectomies were done in 56. Eight aneurysms were deemed not resectable at operation and were treated by internal wiring and external encasing with a steel mesh cloth. This latter double procedure, we believe, has its therapeutic place in nonresectable aneurysms.

Grafts were inserted in the following sites: 13 in the aorta (7 homografts, 6 prosthetic, 0 vein), 19 in the iliac artery (4 homografts, 11 prosthetic, 4 vein), and 44 in the femoral artery (including popliteal grafts) (6 homografts, 16 prosthetic, 22 vein).

As noted, mostly prosthetic replacements were used in the iliac and femoral areas and now prosthetics are even used in the aorta. Thus, the use of a prosthetic graft instead of a homograft increased as the supply of homografts were reduced.

The results of these grafts were as follows: (1) Death—No deaths occurred as a result of a femoral graft, 1 from iliac replacement, and 4 from aortic resection. Percentagewise, this is 0 per cent in the femoral, 5 per cent in the iliac, and 31 per cent in the aortic grafts. (2) Amputation—There were 2 amputations in the patients with early vein grafts in the femoral area but none in those with homografts or prosthetic grafts. There were no amputations after aortic grafts (homografts) and 1 after an iliac graft (prosthetic).

COMMENTS

The degree of success or failure of the graft often cannot be determined. Failure is obvious if the patient loses his life or limb. Success is certain if the major pulses return. If one considers the results successful only if the major pulses return, they would be excellent in 6 aortic (66 per cent), 10 iliac (52 per cent), and 22 femoral grafts (50 per cent) so classified. In a significant number, however, the major distal pulses do not return, but the patient is clinically greatly benefited. Based on these 3 findings, the results of our grafts could be described as successful in 8 of our 13 aortic (61 per cent), 17 of 19 iliac (89

per cent), and 40 out of 44 femoral grafts (90 per cent).

Every series of grafts should be analyzed and reported since the dramatic successes in the literature encourage heroic and, often, hopeless surgical efforts by some unskilled in this field.

The decision to insert a graft must depend upon a knowledge of the disease and its probable course in that particular patient and not on the mere technical ability to insert a graft. While the determination to graft may rehabilitate a vascular cripple, the wrong decision may cause a death or loss of a limb.

Thus, the responsibility for deciding to insert a vascular graft must be known and accepted by the vascular surgeon. It depends upon many factors, both of a local and general nature, but mostly on the years of experience in this field.

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THE DEATH OF JAMES ABRAM GARFIELD

JOSEPH M. MILLER, M.D., F.A.C.S., Fort Howard, Maryland

JAMES ABRAM GARFIELD, the twentieth President of the United States, had a fabulous career in public service. His preparation for that service was excellent. Garfield studied at the Eclectic Institute, Hiram, Ohio, and then at Williams College, Williamstown, Massachusetts, from which he was graduated with high honors. Upon his return to Ohio, Garfield taught the classics at the Eclectic Institute and shortly thereafter he became president of the institution. Coincident with his teaching, he studied law and was admitted to the bar in 1859. Garfield resigned his presidency and was elected to the Ohio State Senate. With the outbreak of the Civil War, Garfield was commissioned a lieutenant-colonel in the Union Army and subsequently was promoted to a brigadier general. He was elected to the House of Representatives of the United States in 1862 and was made a major-general in 1863. Giving up his commission, Garfield took his seat as a representative shortly thereafter. When he was serving his ninth term in the House of Representatives he was elected United States Senator from Ohio by the Ohio legislature. It was not unnatural that such a brilliant leader should be chosen by the two opposing factions of the Republican party as a compromise candidate for President in 1880.

The two issues dividing the Republican party then were the reform of civil service and the treatment of the South. The "Stalwarts," against reform of civil service and advocates of harsher treatment of the South, proposed former President Ulysses S. Grant, who had already served two terms, for a third term. The "Half-Breeds," holding the opposite view on both subjects had chosen Senator James G. Blaine of Maine as their favorite.

At the Republican National Convention held from June 2, 1880 through June 8, 1880, in Chicago, Illinois, the principal candidates were Grant and Blaine. Garfield, the head of the Ohio delegation, nominated Senator John Sherman of Ohio. A long struggle between Grant and Blaine followed. Garfield had not identified himself with either faction in Congress although he had sympathy for the "Half-Breeds." On the thirty-sixth ballot, Garfield was chosen as a compromise between Grant, Blaine, and Sherman.

The Democratic nominee for President was General Winfield S. Hancock. Garfield defeated Hancock in the general election on November 2, 1880. The vote in the Electoral College was Garfield, 214, and Hancock, 155, although the popular votes were extremely close, since of a total of 8,891,083 votes cast, Garfield received 4,449,053 and Hancock 4,442,030. The plurality of Garfield was 7,023 or 0.08 per cent of the total votes cast for both candidates.

This was the period of the spoils system in politics. Charles J. Guiteau, a lawyer from Chicago, was an unknown worker in the Republican party. He believed that the efforts he made in the election of Garfield should be re-

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warded by appointment to political office but he was not successful. The patronage situation between the two factions of the Republican party reached an explosive point at about this time. The thought suddenly occurred to Guiteau that if the President were removed from office, the entire problem of patronage could be solved. All of the subsequent actions of Guiteau were directed toward the assassination of James Garfield.

The 4 months during which the President had been in office had been difficult for him because of differences in thought with a part of the Republican party and because of the receipt of numerous requests from people seeking office. In addition, Mrs. Garfield was recovering from a severe attack of malaria. Garfield planned with anticipation of much pleasure a vacation to start on July 2, 1881. He wished to go to Williams College to attend the commencement on July 3, to celebrate the twenty-fifth anniversary of his graduation with the class of 1856, and to enter his two sons in the freshman class of the next academic year.

Guiteau had allowed many opportunities to shoot the President to pass. From the newspaper, however, Guiteau had learned the time of Garfield's departure on his vacation, and so was at the Baltimore and Potomac depot early on the fateful day. As the President and James G. Blaine, the Secretary of State, passed through the ladies' waiting room to the track at about 9:20 a.m., Guiteau, following, walked up to within about 6 feet of the President and, without warning, shot at the back of Garfield twice with a British bulldog revolver. The first shot only penetrated the left side of the traveling coat of the President but the second entered the right lower thorax.

Dr. Smith Townsend, the Health Officer of the District of Columbia, was the first physician to reach Garfield, and arrived about 5 minutes after the President was wounded. During a rapid examination, the doctor introduced his finger into the wound. His immediate treatment consisted of the administration of a half ounce of brandy and a dram of aromatic spirits of ammonia orally.

Blaine called Dr. D. W. Bliss, a prominent surgeon of Washington, to care for the President. Dr. Purvis arrived soon after and Surgeon J. S. Woodward of the United States Army was summoned later.

Garfield complained of weight and numbness of his lower extremities. Subsequently, a tingling sensation over the same areas was noted.

Bliss found that the ball had entered the President about 4 inches to the right of the vertebral column on a line with the eleventh rib. The wound was explored by the doctor, in turn, with a Nélaton's probe, the little finger of his left hand, and a flexible silver probe. Drs. Reyburn, Lincoln, Ford, and Surgeon Norris of the United States Army had meanwhile added themselves to the group of attending physicians. Bliss reported the results of his examination to the doctors and suggested that further examination and treatment be postponed. Temporary dressings were applied to the wound.

The President wished to return to the White House and so he was transported there by a horse-drawn ambulance. His general condition was poor and he was still in a state of surgical shock. Garfield was placed on his right side in an effort to promote drainage from the thoracic wound. Morphine, grain 1/8, and atropine, grain 1/150, were injected at 10:00 a.m. and morphine, grain 1/6, at 11:00 a.m. At 3:00 p.m., Dr. Bliss, Surgeon-General Philip S. Wales, United States Navy, Surgeon J. S. Woodward, United States Army, Surgeon Norris, United States Army, Drs. Robert Reyburn, Smith Townsend, Patterson, Purvis, and Lincoln carefully reviewed the clinical condition of the President.

The clothing of Mr. Garfield was removed at 5:00 p.m. A catheterization of the bladder was done at 6:00 p.m. Nausea and vomiting were severe in degree but water was given orally frequently because of extreme thirst.

At 7:00 p.m. another consultation was held. Bliss and Wales examined the wound and Wales inserted his little finger into the wound between the tenth and eleventh ribs. The doctors concluded that hemorrhage from the liver had occurred and that the President would not survive the night.

The volunteer staff of nurses for the first day and night were Mrs. Blaine, Mrs. Windom, Mrs. Hunt, Mrs. James, and Mrs. McVeagh, who were wives of members of the cabinet. Their places were taken by Dr. Susan Edson, a homeopathic physician.

On July 3, Garfield placed himself in the care of Dr. Bliss, who requested the help of Surgeon-

General Barnes, Drs. Woodward, Reyburn, D. H. Agnew of Philadelphia, and F. H. Hamilton of New York City. Dr. Agnew and Dr. Hamilton arrived on July 4. Probes and flexible bougies were inserted into the wound by Agnew and Hamilton to determine the course of the ball. It was apparent that the kidneys, intestine, and peritoneum were not injured. The doctors thought that the missile had passed into the pelvic cavity. Incision and dissection for exploration were discussed but all of the surgeons concluded that the now favorable clinical progress of the patient militated against operation. By the evening of July 4, the pain, the hypesthesia of the scrotum, and the vomiting had nearly disappeared.

The people of the country were concerned not only with the immediate well-being of the President but also with the economic status of his family if he should die. On July 6, Cyrus W. Field, a successful merchant of New York City and the promoter of the first transatlantic cable, sent a message by cable and telegraph to friends in Europe and America stating that if the President should die, he would leave his wife and 5 children about $20,000.00. Field asked for donations and subscribed $5,000.00 himself. The subscriptions ranged from $5,000.00 to 10 cents. The fund eventually reached $362,238.52 and was deposited in the United States Trust Company.

The press, particularly the medical, followed the condition of the President closely (3). The main concern was the location of the ball and considerable guessing was undertaken regarding the site at which it lodged. One remarkably astute observer wrote that the after-effects, however, in the shape of possible secondary hemorrhage, abscess, sloughing, and the usual pathologic processes attending gunshot wounds in that region must be viewed with the greatest of anxiety.

As early as July 16, the results of an experiment to determine the course of the bullet were published (11). The gun used by Guiteau was a British bulldog revolver which carried a .44 central fire cartridge. Twenty grains of powder were used to propel a bullet of 200 grains. Bullets were fired into a cadaver to determine the type of wound produced, the penetrating power of the ball, and the diminution in force effected by the impact of missile upon bone. An anatomic description was written to help the attending physicians and surgeons to determine the course of the bullet in the President.

Editorial comment on July 16 was that, though probing of the wound might have revealed the course of the bullet, the physicians exercised considerable forbearance in the procedure (4). Their opinions on the course of the ball were based upon conjecture rather than fact. The facts that location of the bullet and its extraction could not ameliorate the symptoms of the patient were freely recognized.

The clinical course of the patient was a series of crises and recoveries. A gradual deterioration, however, was evident. On July 21, a collection of pus was observed extending below the twelfth rib toward the erector spinae muscle and under the latissimus dorsi muscle on the right side. The purulent material was evacuated with each change of the dressing. A chill and an elevation of the temperature to 104 degrees F. occurred on July 23. The physicians did not believe that this superficial and limited collection of pus was the principal cause of the aggravation of the condition of the patient. A free incision of the abscess was made, however, to afford a more direct and dependent channel to the affected rib, from which a small piece of bone was removed.

Improvement was not prompt, and on July 26 the opening between the ends of the fractured eleventh rib was enlarged and a small detached fragment of bone was removed. This procedure provided better drainage.

Although the physicians realized that the ball was probably not causing difficulty, the thought persisted that if the bullet were located, it could be removed and the life of the President spared. Alexander Graham Bell undertook considerable experimentation to perfect an induction balance to find the ball. On the evening of July 26, Bell took the electromagnetic apparatus to the executive mansion and made an effort to locate the bullet. Because of some unknown reason, a balance was not obtained and the results were uncertain and indefinite. An error in connecting the condenser was found later. Bell returned to the White House on August 1, but again the ball was not found. Subsequently, the apparatus was improved but it was not used again. Later, Bell stated that the results of postmortem examination proved that the bullet was too far from the surface of the body to affect the device.

On August 6, an elevation of the temperature occurred again. A collection of pus extended

TABLE I

	Requested	*Awarded*
D. W. Bliss, M.D., Washington, D. C.	$25,000.00	$ 6,500.00
D. Hayes Agnew, M.D., Philadelphia, Pa.	$14,700.00	$ 5,000.00
Frank H. Hamilton, M.D., New York, N. Y.	$25,000.00	$ 5,000.00
Robert Reyburn, M.D., Washington, D. C.	$10,800.00	$ 4,000.00
Silas A. Boynton, M.D., Cleveland, Ohio	$ 4,500.00	$ 4,000.00
Susan A. Edson, M.D., Washington, D. C.	$10,000.00	$ 3,000.00
D. S. Lamb, M.D., Washington D. C.	$ 1,000.00	Disallowed
	$91,000.00	$27,500.00

TABLE II

Total amount for medical services and attendance.	$27,500.00
Services and supplies of miscellaneous character.	$ 6,853.01
Allowances to employees of government for extra services	$ 5,440.00
	$39,793.01

from the opening, made previously, toward the crest of the ilium on the right side, a distance of about 7 inches. Under local anesthesia, an incision was made into the area. A point of dependent drainage, however, was needed. On August 8, under general anesthesia, produced by ether, the previous excision was extended.

Because the heat of the Washington summer was great, an electrical air cooling apparatus devised by Jennings of Baltimore was installed and used successfully (9). It was a cast iron chamber 10 feet long, 3 feet wide, and 3 feet high filled with vertical iron frames covered with cotton terry or turkish towelling, placed ½ inch apart. The screens afforded 3,000 square feet of cooling surface. Immediately above the vertical screens was a coil of iron pipe, 1 inch in diameter, whose lower side had many fine perforations. Iced water was constantly sprayed over the sheets. An opening, 13 inches square, was at each end of the chamber. The outer end of the chamber was connected by pipe with an outdoor air conductor. The outlet at the opposite end of the chamber led to an ice chamber. A pipe with an exhaust fan drew air from the bottom of the ice chamber into the room. Outside air received at 99 degrees F. was supplied at the rate of 22,000 cubic feet per hour at 54 degrees F. With the windows and doors open, the bedside temperature was maintained steadily at 75 degrees F. day and night.

Real improvement in the condition of the President did not follow the operations. A further complication, parotitis on the right, was noted on August 18. During the course of the parotitis, paralysis of the right facial nerve occurred and continued with but slight improvement until the time of death. Incisions were subsequently made to liberate the pus. On August 26, a free discharge of pus into the external auditory canal and the mouth on the right side was noted.

Continued slow physical deterioration took place. The weight of the patient declined from 205 to 210 pounds before injury to 125 to 130 pounds on August 23. The inflammation of the mouth extended by continuity to the pharynx, larynx, trachea, and bronchi. An acute bronchial catarrh was the sequel. A bilateral hypostatic congestion of the lungs, greater on the right than the left, became evident.

The removal of the President to a more salubrious climate had been discussed by the doctors for several days. Finally, the majority of the surgeons decided that the patient should be moved to the seashore. The journey from the executive mansion to Elberon, New Jersey, was effected without incident on September 6.

A slight improvement followed the change of environment. The President was so pleased that he requested a reduction in the number of professional attendants. Surgeon-General Barnes, Surgeon Woodward, and Dr. Reyburn retired from providing care for Garfield.

This minor improvement in condition was followed soon by repeated elevation of the temperature. Bliss was in constant fear of catastrophe. His poor prognosis was justified for Garfield died on September 19.

The arrangements for autopsy were completed rapidly. Surgeon-General Barnes, Surgeon Woodward, and Dr. Reyburn were invited to return and did so. Acting Assistant Surgeon D. S. Lamb of the Army Medical Corps was asked to participate at the suggestion of Surgeon Woodward. Dr. A. H. Smith was also invited. The autopsy was done by Acting Assistant Surgeon Lamb.

A hematoma concealed the spleen and the left margin of the greater omentum and extended down the left side into the pelvis. A right subphrenic abscess and a subcapsular abscess of the left kidney were present. The bullet had gone behind the right kidney through the body of the first lumbar vertebra lodging immediately below the lower border of the pancreas 2½ inches

from the midline. A long extraperitoneal sinus extended from the wound to the right side of the pelvis. The right eleventh and twelfth ribs were fractured. The splenic artery was torn for 4/10 inch, 2½ inches from its origin at the coeliac axis. Hemorrhage from an aneurysm of the splenic artery was the immediate cause of death.

Considerable criticism was directed toward the attending doctors. The medical profession was advised that the best tribute, which they could pay to the memory of the President and the dignity of the art which they practiced, was to avoid carping criticism of the methods of medical attendance, to prevent scandal because of private grievance, and to use charity, so well deserved, broadly toward those who worked with untiring faithfulness for the life which they had in charge (5). Retrospect observation did not disclose, moreover, any different mode of treatment which could have saved the life of the patient.

Notwithstanding the advice offered, it was necessary to discuss again the subjects of treatment and malpractice (6). Editorially, it was pointed out that the majority of the profession agreed that death was inevitable although not a few maintained an opposite view. Criticisms regarding the plan of treatment, however, were scarcely becoming to those who never saw the patient.

Such editorials did not stop questions or criticism. In a dissenting voice, Turnipseed asked whether the treatment given was in agreement with concepts of modern surgery. The author suggested that before the wound was probed, the relative positions of assailant and assailed should have been investigated to help in the localization of the bullet. In addition, he noted that the probing by Bliss might have created false passages. Turnipseed suggested that a bullet forceps of his design would have followed the tortuous path of the ball, seized it, and brought it to the wound at the point of entry.

Esmarch, Professor of Surgery at the University of Kiel, criticized the treatment of Mr. Garfield before the Physiological Society of Kiel. Esmarch objected to the apparent lack of antiseptic treatment. He criticized the 3 examinations of the wound by finger, the introduction of probes of questionable nature, and the use of questionably antiseptic dressings. The conclusions of Esmarch were interesting. The wound was not mortal for neither liver nor intestines were injured. The bullet was not the cause of the suppuration for it probably did not carry septic material into the wound. The cause of the suppuration must have been introduced from the outside by either probe or finger. The infection was spread by squeezing the wound. Sufficient means of drainage of the wound were not provided.

The fees asked by the physicians for services rendered during the period of illness are of interest (8). A board of members of the House of Representatives of the second session of the forty-seventh Congress of the United States convened on November 11, 1882 and adjourned from day to day until December 11, when all questions were resolved. The awards were paid on December 12 (Tables I and II).

The care of the President placed grave responsibility on all of his physicians. Assuredly, their treatment of Garfield was consistent with the best opinions of the time.

Guiteau was rapidly apprehended after he shot the President. The trial of Guiteau was the first in the history of the United States for the assassination of a President. The chaotic court proceedings, held in the Supreme Court of the District of Columbia, in Washington, District of Columbia, were presided over by Judge Walter S. Cox. In the trial which lasted about 10½ weeks, the sanity of Guiteau was the center of discussion. The jury took 1 hour and 5 minutes to conclude that Guiteau was sane and guilty. Judge Cox sentenced the prisoner to death. Guiteau was hanged on June 30, 1882 in Washington, D. C.

The public services rendered by Garfield led to his death. He was a brilliant person with qualities of leadership which made him acceptable to the two dissident factions of the Republican party in 1880. As a dark horse candidate, Garfield was elected by a vote, which if only slightly shifted in certain areas, would have led to his defeat and, therefore, the sparing of his life.

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Reviews of New Books

THE PRESENT EDITION of *Die geburtshilflichen Operationen; ihre Ausfuehrung und Anwendung*[1] is the eighth to appear in 24 years. The information on the jacket states that it has been shortened, but actually there are only 9 pages less and 15 fewer illustrations than in the previous edition. The table of contents is identical with that of previous editions. A few obsolete procedures, such as the use of rubber bags to dilate the cervix were either omitted entirely or the space devoted to them has been curtailed, as in the description of symphysiotomy and destructive operations on the child. A few rare obstetric operations are still described and illustrated because the author believes that a textbook on operative procedures should be the place where an obstetrician can readily find assistance when he needs it.

Martius is still the dean of authors of German books on obstetrics and gynecology. The eighth edition, undoubtedly, will be as popular as the previous editions in German-speaking countries and, believe it or not, the price of the 1957 book is a dollar less than the 1953 edition. —*J. P. Greenhill.*

TO THOSE who are familiar with the first edition of *Textbook of Gynecology*[2] by John I. Brewer, and its predecessor *Gynecology* by the same author in 1950, the publication of the second edition of this volume has been an eagerly awaited event. Those who read the new second edition will not be disappointed as it embodies the best in the first edition with up-to-the-minute revision and additional material of great practical value and importance. Providing as it does a double approach to gynecology, Brewer's book remains unique in this field. Part 1 is devoted to the clinical presentation of this subject—as it is actually used in practice. Part 2 presents the material in the classical entity style. As a teaching method, this presentation has stood the test of student acceptance and interest, as well as proved effective. The clinical approach makes this volume particularly useful to all who practice gynecology, be they residents, generalists, or specialists.

This edition has been increased in size by approximately 200 pages which include a new section on gynecology during childhood and a new chapter on endocrinology. The former includes an easily understood presentation of that part of the embryology of the genital tract which is of practical importance to the gynecologist. The diagrammatic illustrations are excellent.

The chapter concerning endocrinology, written by E. J. DeCosta, in addition to a remarkably complete coverage of the clinical aspects, makes clear the chemical terminology of the steroid compounds which are so confusing to the clinician without broad background in chemistry. Further, more than 50 figures have been added, mostly gross specimens and photomicrographs of superb quality and great illustrative value. An improved method of organization of the clinical material in Part 1 has been used which is oriented along the lines of growth and development. The considerable increase in space devoted to treatment enhances the value of this volume to the practitioner.

As in the past, Brewer's style of writing leads to easy understanding, pleasant reading, and useful organization of material. The format of the volume is attractive, the type highly legible, and the workmanship excellent.

This is a textbook which should be required reading for all students of gynecology.

—*Ben M. Peckham.*

THE IMPOSING VOLUME of nearly 1200 pages in it fourth edition, *Lehrbuch der roentgenologischen Differentialdiagnostik*,[3] itself testifies to the favorable reception it has been accorded in German reading circles. One reviewer in speaking of the specialties likely to be helped by the book mentions practically every one but psychiatry. Really, it is a very useful work, superbly produced, with excellent illustrations, and exceptionally thorough in its discussion of the various subjects. Not only the diagnostic applications of bronchography are fully elaborated, but the technique as well.

The section on the heart is provided by Dr. Thurn, based on the enormous clinical material of the Martinischen Klinik of Bonn. The roentgencinematographic process, so far advanced in Janker's Clinic in Bonn, as well as the new cardiologic skills developed by Prof. Grosse-Brockhoff, Dr. Schaede, and others in the surgical clinic at Düsseldorf, have all been set forth in great detail. Arteriography of congenital cardiac lesions is given considerable space, as well as the diagnosis of cardiac disease in general. There is an excellent section on differential diagnosis of acquired and congenital anomalies of the pulmonary vessels. Catherterization of the heart is given its place, with excellent studies on heart shunts.

Nearly 100 pages are devoted to the esophagus and its diseases. Finally, the diaphragm is studied with reference to the differential diagnosis of its roentgenologically visible changes.

It is difficult to find any subject relating to diseases of the chest which is not considered in this valuable work. It should find an important place in the library of all physicians dealing with diseases of the thoracic organs, especially radiologists, internists, and thoracic surgeons. —*James T. Case.*

[1] DIE GEBURTSHILFLICHEN OPERATIONEN; IHRE AUSFUEHRUNG UND ANWENDUNG. By Prof. Dr. Med. Heinrich Martius. 8th ed., 281 pages, illustrated. $7.05. Stuttgart: Georg Thieme, 1957.

[2] TEXTBOOK OF GYNECOLOGY. By John I. Brewer, B.S., M.D., Ph.D. 2nd ed., 742 pages, illustrated. $15.00. Baltimore: Williams & Wilkins Co., 1957.

[3] LEHRBUCH DER ROENTGENOLOGISCHEN DIFFERENTIALDIAGNOSTIK. Vol. I. ERKRANKUNGEN DER BRUSTORGANE. By Prof. Dr. Werner Teschendorf assisted by Priv. Doz. Dr. P. Thurn. 4th rev. ed., 1183 pages, 1138 illustrations. $50.00. Stuttgart: Georg Thieme, 1958.

THE FOURTH EDITION of *The Pharmacologic Principles of Medical Practice*[4] is an enlarged version of previous volumes and now contains 1313 pages with 59 tables and many new figures and illustrations. In common with former editions, considerable attention is given to the historical development of pharmacology, and an attempt is made to illustrate with well known therapeutic agents the rationale underlying their use in medical practice. In addition, the number of drugs in the fourth edition exceeds that in the third edition by 140, and now brings the coverage up to those listed in the fifteenth edition of the United States Pharmacopeia and the tenth of the National Formulary.

Two new chapters describing drugs used in the treatment of mental illness and local use of drugs in diseases of the ear, eye, nose, and throat have been added.

The coverage of drugs and their action is broad rather than deep and this has resulted in a rather limited bibliography at the end of various chapters.

In general, the book fulfills its purpose of describing drug action, with reference to clinical application, aimed at the medical student and practicing physician. —*Alexander C. Keyl.*

EIGHTEEN YEARS have elapsed since publication of the first edition of *Gynecologic and Obstetric Pathology*[5] by Emil Novak, and it is reasonable to believe that this textbook has been the authority in its field for a large segment of the current generation of obstetricians and gynecologists. Obviously, the responsibilities of authorship were not lightly accepted by this great teacher, as evidenced by the appearance of subsequent editions in 1947 and 1952. The fourth edition, co-authored by Edmund Novak, maintains the scholarly standards set by the 3 previous volumes. Recent literature has been drawn upon freely, and the bibliography contains references through 1956. If, here and there, controversial issues have been lightly skirted, it apparently is with the intention of acknowledging their existence without confusing the student with a multiplicity of unproved details.

The volume has been enlarged from the first edition by more than 150 pages and nearly 250 illustrations, and 1 new chapter on exfoliative cytopathology has been added. Although some of the photomicrographs and drawings are weak, the over-all quality is good, and the color photographs are especially effective. The inevitable proofreader's oversights are but minimal, and the format has been well executed to provide the greatest ease of reading.

Basic relationships of pathology to normal and abnormal physiology of the reproductive tract are emphasized, and the discussions of the menstrual cycle and of exfoliative cytopathology are excellent.

Ten chapters, embracing some 137 pages, are devoted to a discussion of ovarian tumors, including the non-neoplastic cysts. These are among the best chapters in the book. Close familiarity with even the most current literature is manifest. Various theories of histogenesis are scrutinized and arguments for and against acceptance are offered on a basis of mature judgment. A wealth of pathologic material is analyzed from the authors' personal series, from a study of a vast registry storehouse, and from examination of reported series of cases. Illustrations are such that the pathologist encountering for the first time an unfamiliar ovarian new growth could reach a reasonably accurate diagnosis by reference to this one text.

Although the description of carcinoma in situ reflects the growing concordance of opinion of both pathologists and clinicians, this reviewer must disagree with the statement that "if definite invasive cancer is excluded [during pregnancy] the problem is purely academic. Even if the suspected lesion is a true pre-invasive cancer, its course is not apt to be so rapid as to warrant termination of pregnancy and complete treatment. Expectant therapy with repeat biopsies will not jeopardize the patient in any way, and should lead to proper diagnosis." Although rapid progression from preinvasive to invasive cancer admittedly is not likely to occur, such a change can take place and to most clinicians the problem would seem more than academic.

Exception should be taken also to the failure to distinguish, both grossly and microscopically, between leucoplakia of the vulva and lichen sclerosis et atrophicus. Describing the latter condition as simulated by "atrophic leucoplakia" serves only to perpetuate the old confusion with regard to these lesions of the vulvar skin. Inclusion in this section of a description of lichenification of the skin subsequent to repeated trauma might be valuable to emphasize the clinical importance of that most common complaint, pruritus vulvae of undetermined origin.

A misleading impression is created in the section devoted to the endocrine function of the corpus luteum. After noting that this structure produces estrogen and progesterone, the authors mention "a third principle, luteotrophin," leaving one uneasy from the indication that this too might be manufactured in the ovary.

Aside from the minor criticisms noted, both the pathologists and the clinician who reviewed this book can recommend it to any who need a basic knowledge of obstetric and gynecologic pathology or a guide to its further study. —*M. Elizabeth Mussey.*

THE TEXT of 820 pages, 109 tables, and more than 600 illustrations by George T. Pack and Irving M. Ariel[6] describes in detail tumors of the soft somatic tissues and their clinical management. It is based upon a review of the largest group of sarcomas ever studied. The material was accumulated for the most part at the Memorial Center for Cancer and Allied Diseases and the Pack Medical Group in New York City. In the preface, the authors suggest that the

[4]THE PHARMACOLOGIC PRINCIPLES OF MEDICAL PRACTICE; A TEXTBOOK ON PHARMACOLOGY AND THERAPEUTICS FOR MEDICAL STUDENTS, PHYSICIANS, AND THE MEMBERS OF THE PROFESSIONS ALLIED TO MEDICINE. 4th ed. By John C. Krantz, Jr. and C. Jelleff Carr. 1313 pages, illustrated. $14.00. Baltimore: Williams & Wilkins Co., 1958.

[5]GYNECOLOGIC AND OBSTETRIC PATHOLOGY; WITH CLINICAL AND ENDOCRINE RELATIONS. 4th ed. By Emil Novak, M.D., D.Sc.(Hon.), F.R.C.O.G.(Hon.), and Edmund R. Novak, M.D. 650 pages, 683 illustrations, 25 in color. $14.00. Philadelphia and London: W. B. Saunders Co., 1958.

[6]TUMORS OF THE SOFT SOMATIC TISSUES; A CLINICAL TREATISE. By George T. Pack, M.D., LL.D., F.A.C.S., and Irving M. Ariel, M.D., F.A.C.S., with 15 collaborating authors. 820 pages, 652 illustrations. $30.00. New York: Paul B. Hoeber, Inc., Medical Book Department of Harper & Bros., 1958.

greatest value of the book perhaps lies in the fact that all were diagnosed and treated by a single group of physicians with treatment policies subjected to group judgment.

No previous monographs have been published on tumors of the soft somatic tissues. This is surprising in view of the fact that several sizable volumes have appeared on the subject of bone tumors, a less common site for primary benign and malignant neoplasms.

The classification of soft somatic tumors used by Pack and Ariel is a slight modification of the one proposed by Arthur Purdy Stout at the combined symposium of the National Cancer Institute and the American Cancer Society held in Memphis, Tennessee in 1949. There are 56 categories of tumors or tumor-like growths of which 35 are benign and 21 malignant. Pack and Ariel's volume is based on a study of 717 sarcomas collected during a 25 year period. The histologic diagnosis in each instance was made by one of the following pathologists: James Ewing, Fred Stewart, Frank Foote, Arthur Allen, James R. Lisa or George K. Higgins. Two hundred and sixty-one (36 per cent) of the 717 sarcomas could not be diagnosed as to their tissue of origin.

Since this is the first book on the subject to contain extensive data on the clinical features of these tumors and results of therapy, the authors have made the book all-embracing, discussing the various disciplines that contribute to the cure of the patient. The text is divided into 6 sections. Section 1 is a consideration of the natural history of tumors of the soft somatic tissues, their classification, incidence, hereditary and congenital occurrence, the roles played by trauma and other etiologic factors, and the question of malignant degeneration of benign somatic tumors. Section 2 discusses techniques of therapy including wide local excision, resection of the tumor and its lymph node metastases as a monobloc dissection, amputations, and radiation therapy. Section 3 describes the tumors which comprise this neoplastic group as well as certain tumor-like or preneoplastic proliferations. Section 4 is devoted to sarcoma of infants and children. Section 5 presents the principles of treatment of these neoplasms when they occur in certain anatomic locations such as the neck, the abdominal wall, the buttocks, and the retroperitoneum. Section 6 summarizes the end results of the treatment of malignant tumors of soft tissues. The material in this section is presented in beautifully organized charts and tables. The various factors which influence prognosis are discussed in detail. The over-all, 5 year survival rate without recurrence of sarcomas of soft somatic tissues is 39 per cent.

The authors stress that the choice of treatment of these tumors should not rest solely on the pathologist's report. Rather, proper therapy depends not only on the histologic criteria but, more importantly, upon the location of the tumor, the extent of its invasion, its mobility, its fixation or adherence to joint capsules, and many other factors that only clinical examination can ascertain.

This is an authoritative work containing a large amount of information. It is an important reference book which should be part of every medical school and hospital library and of many private libraries. There has been a great need for such a volume to clarify the classification and management of these tumors and to dispel the confusion about then which exists in the minds of many physicians. A better understanding of these lesions will result in the saving of lives for which the medical profession and the public will owe Pack and Ariel a debt of gratitude.

—*F. W. Preston.*

IT IS UNFORTUNATE that Te Linde's introduction in the salient book, *Abdominal Operations by the Vaginal Route*,[7] may not simply be sent to various journals as a sort of universal book review. Te Linde says, with his usual brevity and perception, the best of what should be said about this book, which is rather more of a manual than an atlas. Its chief virtue consists in the meticulous Germanic, if not actually Prussian, manner of the presentation of techniques. Nowhere will be found a more useful and lucid description of the minutiae of the vaginal approach. The unassuming modesty and lack of pomposity of the authors are interesting and indeed refreshing—time was when we deferred almost by instinct to the German or Viennese pronouncements; yet, their presentation is touched with the automatic precision and the obviously almost terrifying discipline which must be required of assistants and the operating staff. Equally useful and unusual are the authors' minute description and depiction of strategic instruments, which we hope are locally available.

Since the early century, unprejudiced observers have been frightened by the physical energy and the perspiration exhibited by the Germanic school of vaginal surgeons. The "pullenklampenpak" technique of the early days did not too much impress our less arduous newer school. To be sure, one has to read between the lines and to have had a certain amount of personal experience to realize the arduous aspects of some of the feats of surgery which are described in this volume. However, if one is given to misgivings, he may at once join this reviewer in a sense of composure by studying the technique of the backlog safety factor which is the Logothetopulos tampon. This is a magnificent balloon pack which has been demonstrated by its originator in the performance of a complete vaginal hysterectomy without the application of a single ligature! To have an impressive device of this sort to fall back upon is indeed heartening. I am under the impression, though, that American operators might prefer not to have such an occasion arise. In other words, one's feeling might be tinged with the same concern which we now hold for the use of indwelling clamps and other archaic techniques. This matter is touched upon as reflecting considerable experience, and it is intended, perhaps in an angular fashion, to indicate that even in skilled hands the more gymnastic procedures described in this book are not always likely to proceed with the calm orderliness with which they are pictured.

Should any one of these more athletic procedures be indicated, an operator can do no better than to study

[7] ABDOMINAL OPERATIONS BY THE VAGINAL ROUTE. By Paul Werner, M.D., and Julius Sederl, M.D. Translated by L. M. Szamek, M.D. With a foreword by Richard W. Te Linde, M.D. 165 pages, 120 illustrations. $9.00. Philadelphia and Montreal: J. B. Lippincott Co., 1958.

the astonishingly clear and rational techniques of these authors. They describe in minute and helpful detail every rational (and some irrational) procedure which may be performed per vaginam. It is this reviewer's impression that no volume to date has done this job so well. We believe that no operator, regardless of his experience, can fail to profit by many salient points in the authors' directions.

The illustrations which have been chiefly done by Enterdresser and Hepier are superb. The artists have somehow caught the stress and strain, not the confusion, of the operative scene, and there is a sense of the work and none of the abstract bloodless inutility of so much so-called surgical art. Second to the authors' conscientious discussion of techniques the art work is in itself magnificent.

One worries a bit over the concept that the obvious adequacy of Werner and Sederl's description may seduce unskilled operators into undertaking these sometimes rather dreadful operations. This reviewer wishes to point out what is said only vaguely by the authors, that in this difficult field there is no substitute for experience. There is no available teaching which can obviate the pitfalls. Therefore, in spite of the confidence which may result from the mastery of this text, inexperienced operators are to be cautioned.

On the other hand, for the thoroughly experienced operator, particularly be he not of the Germanic school, it appears that the ultimate detail of some of these descriptions—that is to say, the necessity to attempt to follow slavishly the techniques—may be less, rather than more, helpful. We have always maintained that the surgeon par excellence per vaginam must be a man of much recourse and discernment, who may better ad lib his necessities according to the present availabilities, and do the necessary work by virtue of his innate skill, than to try to learn by heart any such rote material as is presented in portions of this book. Experienced operators will soon find that the situation too often varies too much from the text.

The authors actually, and Te Linde by indirection, put us all under the onus to use the vaginal route when it may best serve the interest of the patient. They will not permit us to use the abdominal approach by preference merely because we are better equipped to do so. We are prepared to ride along with this philosophy up to and perhaps a little beyond the usual acceptance. However, when it comes to the removal of ovarian cysts (always potentially malignant), of large adherent fibroids, and adherent adnexa, we are tempted to believe that there are many instances in which every factor is better served by laparotomy except the vanity of the operator. I think the majority, even of the veterans in this field, are in agreement.

So, with an inner apology for our early obeisance to the originators of per vaginam approaches, we can regret that there is in this otherwise meticulous book so little to precise for the casual operator the errors of omission which, on the grand scale of these descriptions, utterly ignore the small individual necessities of support against recurrent cystourethrocele and more especially enterocele. The majority of the not so modern American surgeons could be better aided by instruction in those more insidious betrayals of workaday vaginal surgery than by countless pages of dramatic, if adventitious, technique.

—Goodrich C. Schauffler.

THE BOOK entitled *Ulcerative Colitis*,[8] is well written, and the narrative form employed by the author enhances easy reading. The volume will be useful as a reference work for those interested in the subject of ulcerative colitis, for those who will study the inception and causation of the disease in the future, and more particularly for those who are interested in the surgical approach to this disease. The title of the book might properly be, *Surgical Treatment of Ulcerative Colitis*, because much of the book is devoted to that phase of the subject. The book is profusely illustrated but contains too many similar illustrations of specimens of diseased colon.

The chapter on causation brings this much debated subject up to date, but leaves many questions unanswered for those who in the future may be interested in this phase of research. More space could have been devoted to the medical treatment for this disease, since at least 80 per cent of the patients who have ulcerative colitis constitute medical problems. The opinion is expressed that all patients who have mucosal tags or so-called pseudopolyps should undergo colectomy. Few physicians with a large experience with this disease will agree with this opinion.

The various forms of ileac stomas are described, and complications which follow the creation of an ileac stoma are outlined. These complications might well have been accorded more detailed discussion. Considerably more could have been said about the problems which the person who finds it necessary to have an ileac stoma may encounter. The author is to be complimented upon the very generous discussion of the various mechanical appliances and the proper care of the ileac stoma. The commentary on the patient's adjustment to existence with an ileac stoma also is valuable.

—J. Arnold Bargen.

A SUPERBLY WRITTEN BOOK by two outstanding authorities on the subject is entitled *Erythroblastosis Fetalis Including Exchange Transfusion Technic*.[9] In the short span of 143 pages Allen and Diamond have clarified the current status of erythroblastosis, its diagnosis, prognosis, and therapy. The chapter on exchange transfusion is excellent in its detail and helpful clinical suggestions for successful technique. A chapter of suggestions for nurses and one on hints to laboratory technicians are both very practical. Erythroblastosis caused by A or B blood factors is also discussed. The book concludes with an excellent list of references and a glossary of pertinent terms.

This power-packed book can be heartily recommended to obstetricians, pediatricians, serologists, and

[8]ULCERATIVE COLITIS. By Harry E. Bacon, B.S., M.D., Sc.D., LL.D., F.A.C.S., F.A.P.S. Foreword by Alton Ochsner, B.A., M.D., Sc.D., F.A.C.S., F.A.P.S.(Hon.). With contributions by Paul T. Carroll, B.S., M.D. Chapter on Anesthesia by Leroy W. Krumperman, M.D. 395 pages, 184 illustrations. $15.00. Philadelphia and Montreal: J. B. Lippincott Co., 1958.

[9]NEW ENGLAND JOURNAL OF MEDICINE MEDICAL PROGRESS SERIES. ERYTHROBLASTOSIS FETALIS INCLUDING EXCHANGE TRANSFUSION TECHNIC. By Fred H. Allen, Jr., M.D., and Louis K. Diamond, M.D. 143 pages, illustrated. $4.00. Boston and Toronto: Little, Brown & Co., 1958.

those in allied fields who encounter erythroblastosis. Most of the material in it originally appeared in the Medical Progress Series in October 1957 of the New England Journal of Medicine but the section on exchange transfusion technique is entirely new.

—*Charlotte Herman Kerr.*

A COMPILATION of more than 5,700 terms with their derivations and history combined with great personalities of medicine are presented in the volume entitled *The Story Behind the Word*.[10] In the expressed opinion of its author, the volume is a "veritable treasure house of linguistic adventure and gives to medical terms a new and fuller meaning." This comfortable sense of accomplishment, it must be conceded, finds considerable justification in the text.

It is notorious that the ponderous tomes which boast inclusion of all the terms known to the ancient and modern lexicons of medicine are replete with words which, having been respectfully embalmed, should now be interred to await a doubtful resurrection. There are, however, many aged medical terms, especially among those relating to gross anatomy, and visible symptomatology, which have survived and now serve shoulder to shoulder with a new generation. These living words, whether ancient or recent in origin, whether presentational or relational in usage, constitute the substance and the soul of modern medical terminology.

In the treatment of his subject, the author displays admirable discernment though it must be observed that he has reached out and brought to the convention a number of far distant relatives.

Several hundred definitions selected from the book were compared with those of the two largest medical dictionaries in current use. In no instance was there conflict of pronunciation or definition. There was, in the *Story Behind the Word*, however, an enlarged third dimension which probed the hinterland of etymology to bring to the light of day new and shining values. For, despite fluctuation in usage there stands the solid rule that knowledge of the derivation of the word offers to the cultured mind a comprehension of meaning not by other means attainable.

The volume merits a place in the library of every doctor of medicine. —*Philip M. Dale.*

A COMPILATION of the 30 formal papers and of the numerous discussions presented at a conference sponsored by the Surgery Studies Section of the National Institutes of Health held in Chicago in September 1957 is presented in the volume entitled *Extracorporeal Circulation*.[11]

The book is logically divided into 4 sections: Pumps and Oxygenators, The Physiology of Perfusion, The Effect of Perfusion on Organs, and The Heart. However, the material presented in any of these sections is not strictly limited by the title heading it. A few important themes which reflect current trends in the field run through the entire book. One of these is a strong trend toward abandoning low flow perfusions and adopting perfusion rates, during bypass, that approach basal cardiac output for the patient. Many of the technical and physiologic aspects of this concept are discussed in various presentations throughout the book. Another theme concerns elective cardiac arrest during the open repair, and this concept also receives wide acceptance. It brings forth a number of important studies of cardiac metabolism during states of activity and standstill, as well as interesting discussions concerning the pharmacology and technique of arrest. Apparent disagreements and obvious gaps in knowledge indicate directions that further research will take in this important area.

Several different types of oxygenators receive rather enthusiastic support by various essayists, proving only that successful cardiopulmonary bypass can be achieved in different ways. More studies seem to have been done with various bubble oxygenators than with the other types of oxygenators but this may be due, at least in part, to the fact that these oxygenators are simple and cheap rather than that they are the best available type. The fact that some investigators have encountered air embolism while using bubble oxygenators suggests that there may be a trend favoring various screen, disk, or membrane oxygenators instead of bubble oxygenators, but this trend is not yet clear cut. Failing to agree on the best type of oxygenator, the authors and discussers also failed to agree on the best type of blood pump, but this is no surprise for the entire field is new and rapidly changing, and controversy is to be expected.

Because of the dynamic nature of this subject the editor, J. Garrott Allen, considered early publication of the Conference report to be an important objective. He is to be congratulated on his success for this book has appeared far sooner than other similar volumes in the past. It is about as up to date and comprehensive as anything of this nature is likely to be. Early publication was not achieved without some sacrifice, however, and this sacrifice is apparent in some of the discussions. A number of these are unintelligible and others probably do not represent the opinions of the discussers accurately. Apparently it was not possible to allow extemporaneous discussers the opportunity of editing the stenotypist's type script.

This book is an excellent summary of the large amount of work being done on extracorporeal circulation. It will serve as a useful introduction for the beginners and as a text for the many workers already in the field. —*F. John Lewis.*

THE OPERATIVE INDICATIONS, diagnostic methods, surgical technique, and postoperative course of surgical lesions of the liver are covered in the volume *Chirurgia demolitiva del fegato*.[12] The basic premise of the author is that modern surgical technique, resection along anatomic planes with prior control of the vascular pedicles, the possibility of operating under hypothermia, and modern methods of reanimation

[10]THE STORY BEHIND THE WORD; SOME INTERESTING ORIGINS OF MEDICAL TERMS. By Harry Wain, A.A., B.S.M., M.D. (cum laude), M.S.P.H. 342 pages, not illustrated. $8.50. Springfield, Ill.: Charles C Thomas, 1958.

[11]EXTRACORPOREAL CIRCULATION. Edited by J. Garrott Allen, M.D. Assisted by Francis D. Moore, M.D., Andrew G. Morrow, M.D., and Henry Swan, II, M.D. 518 pages, illustrated. $7.50. Springfield, Ill.: Charles C Thomas, 1958.

[12]CHIRURGIA DEMOLITIVA DEL FEGATO. By Vittorio Pettinari. 230 pages, illustrated. Milan: Idos; Padova: Riccardo Zannoni & F°., 1958.

allow one to cut down to a minimum the danger of hemorrhage and thereby eliminate one of the major obstacles to resective surgery of the liver. Such an approach to the problem implies an accurate preoperative evaluation of the location and the extent of the lesion. Diagnostic methods used by the author include extraperitoneal air studies, splenoportography, catheterization of the hepatic veins with hepatic vein phlebography, and aortography.

The pathologic physiology of liver resection is well covered. The literature in the field of surgery of the liver is extensively reviewed.

The author's indications for partial hepatectomy include congenital anomalies, traumatic lesions, chronic inflammatory lesions such as gummas, cystic dysplasias such as solitary cyst, parasitic cysts, benign tumors, and malignant tumors either primary or secondary. The author's series includes 30 cases of partial hepatectomy with no postoperative deaths, and the longest survival following resection of a secondary growth from a gastric adenocarcinoma was 3 years.

A good outline and excellent reproductions of the figures further contribute to make this volume worthwhile reading. —*René B. Menguy.*

IN THE PREFACE of *An Introduction to Experimental Surgical Studies*[13] the author writes: "This book is intended for the post-graduate student engaging in experimental surgery. The aim is to provide a wider range of references and critical commentary . . . from which the young experimentalist can take off into his own researches." The book achieves just that, except that the critical commentary is reserved for the chapters on tissue regeneration, tissue and organ homotransplantation, and genitourinary problems which are of special interest to the author. These chapters are quite complete and should prove helpful to the student undertaking an investigation in these areas. The remaining chapters, which are less complete, are entitled "Low Temperature Studies," "Hypertensive Diseases," "Cardiovascular Problems," "Intrathoracic Problems," and "Gastrointestinal Problems." The vast literature on burns with its many basic studies on shifts of body fluids and electrolytes has been omitted, as has any direct reference to the literature on endocrinology.

The author has recorded an enormous number of references, picking the salient observation from each report. There is a minimum of explanatory detail because he advises consultation with original sources for them. The references are arranged alphabetically by authors after each subdivision of a chapter. The numerical references to each are in the body of the text. The reader may be startled by abrupt definitive statements following a list of 5 to 10 reference numbers and nothing more. The usual typographic errors, which are the bane of every author's efforts, are unfortunately to be found in the text and bibliographies of this volume.

The orientation of this book is from the clinic to the laboratory. Thus, each section bears a title indicating an unsolved clinical problem. In several sections the author has outlined established experimental methods, and in others pressing problems of immediate interest.

This is not an easily read book, but rather is a source of abbreviated basic information for the investigator starting on a research project.

—*Bradford Cannon.*

A PERSONAL RELATIONSHIP is formed between author and reader in the volume entitled *Clinical Heart Disease*[14]; the latter has that comfortable feeling of the student on rounds gathering up what house officers call "the pearls" from Levine's experiences. This work can be read as a story; paragraphs begin with: "I remember a patient with just such a history." It is full of good common sense and high regard for the advice, "to thine own self be true" (which is best exemplified in the chapters on the medicolegal aspects of heart disease, prognosis in heart disease, and heart disease and obstetrics).

As is stated in the preface to this fifth edition, cardiologists have now accepted new responsibilities in selecting patients for surgically correctable conditions. The revision is presented with this new development in mind. The author reviews the recent surgical advances in the treatment of masked thyrotoxicocardiac state, and he speaks strongly for subtotal thyroidectomy even when surgeons are reluctant to operate. The latest indications for surgery in mitral stenosis are given, though unfortunately without many supporting statistics. Also of surgical interest are the differentiating features for diagnosis of arteriovenous fistulas and the descriptions of the surgically correctable myxomas of the auricles.

The text is designed principally for the general practitioner and the internist and, as the title indicates, is strongly devoted to the clinical aspects of cardiac disease. Some incidental operative findings of Aschoff nodules in the auricles alter previously insignificant interpretations of rheumatic fever. In one of the best chapters, "The Development of Rheumatic Heart Disease," Levine stresses the individuality of host reaction to the disease, the necessity for a complete chronologic history, and the question of the significance of chorea in relationship to prognosis. Unfortunately, he gives little aid concerning the use of adrenal steroids in rheumatic fever. The searching questions of the accepted explanations of pain, and a detailed presentation of the mechanism of pain in angina pectoris with a diagnostic carotid sinus test constitute another excellent chapter. The fine points of the use of digitalis, the mechanism of all diuretics, and some personal tragedies in the use of quinidine are indeed worthwhile.

There is too brief a description of cardiac catheterization, and only short reference, with few statistics, to the controversial question of the duration of anticoagulant therapy which Levine recommends for myocardial infarction; yet, these subjects are perhaps outside the scope of his basic theme—clinical medicine.

[13]AN INTRODUCTION TO EXPERIMENTAL SURGICAL STUDIES. By W. J. Dempster, F.R.C.S., 463 pages, illustrated. $10.00. Springfield, Ill.: Charles C Thomas, 1958.

[14]CLINICAL HEART DISEASE. By Samuel A. Levine, M.D., F.A.C.P. 5th ed. 673 pages, 216 illustrations. $9.50. Philadelphia and London: W. B. Saunders Co., 1958.

In this well organized book there is easy access to topics such as functional heart disease, cardiovascular emergencies, systolic murmurs, and surgical risks. Each topic concludes with a personal statement of Levine's interpretations—something the reader can carry away. —*Carl G. Leigh.*

TO THOSE ELSEWHERE who have not yet fully exploited cytodiagnosis in the field of gastroenterology, the work of Henning and Witte[15] in Germany will prove a challenge and inspiration. There are many, feeling fortunate to be able to distinguish the malignant from the benign, who will think these authors daring in their interpretations of the exfoliative specimens examined. None but will heartily agree to the uniform excellence of the numerous black and white photomicrographs, some at very high magnification, which comprise over one-half of the monograph.

This book in the original German with English translation by R. O. K. Schade is indeed an atlas of both the normal and abnormal exfoliative cytology from the oral cavity to the anus, including as well considerations of biliary drainage and ascitic fluid. The authors have included sections dealing with the collection of material and its examination. The limitations encountered are frankly stated.

—*C. Conover Talbot.*

A WELL ORGANIZED TREATISE, *Training of the Lower Extremity Amputee*,[16] covers the problems of the amputee at, and below, the level of a hemipelvectomy. In addition to covering the standard training procedures, the importance of which was established in World War II, attention is given to: (1) The special problems requiring correction before fitting of a prosthesis; of particular import to the surgeon is the preprosthetic rehabilitation of the amputee. (2) A very brief but clear review of nomenclature and the construction of the prosthesis is provided for the better comprehension of the basic mechanics involved. (3) The development of techniques of daily living requiring modification due to prosthetic wear, as well as special techniques required for participation in sports, dancing, and other activities that an individual may desire to attempt. (4) Methods of obtaining answers for some of the unusual and "knotty" questions encountered—as in the elderly and double above knee amputees. (5) Special effort is made to assist the supervisor and the amputee (trainee) in evaluating his progress and to establish reasonable goals of functional efficiency which he may attain, but not necessarily the height of perfection reached by some athletically inclined individual such as the senior author with his 30 years' experience in the training field while wearing a prosthesis.

Indirectly, this book covers the apparent and the less apparent psychologic problems faced by the individual amputee and thus assists him, through the supervisor, to adjust himself to these problems with more rapid rehabilitation and resumption of his economic and social position.

The excellent table of contents and the index serve as a check list of problems and questions that need answering for each lower extremity amputee. In addition, the book is readable; salient points are covered without confusing detail, and the photographs and line drawings further clarify the procedures described.

—*James F. Kurtz.*

A DISCUSSION in outline form is given in *Photokolposkopie und Photodouglasskopie Indikations und Technik*[17] of the history, development, indications, limitations, and technique of both colposcopy and culdoscopy, and the book is illustrated with photographs obtained by these diagnostic procedures. The author maintains that the transfer of knowledge of colposcopy to the sphere of culdoscopy will be the key to effective prophylaxis of internal genital malignancy.

Atypical formations of the cervical epithelium and carcinoma in situ are excellently defined and discussed in relation to the development of invasive carcinoma.

An interesting section on vital staining of both the external and internal genitalia is included. The use of acridine orange, atabrine, Nile blue, and 3-isopropylaminopyrine in ethyl chloride, particularly the latter two, permits differentiation of normal from atypical or malignant tissues by virtue of characteristic fluorescence. This observation leads the author to state that, in the future, diagnosis of cancer may be possible even without histologic confirmation.

The latter part of the book is devoted to a series of "photoculdograms" and "photocolpograms," all of which are outstanding in both detail and color reproduction. These pictures cover 67 pages.

—*Maynard Guderian.*

IN THEIR BOOK entitled *Gastrectomy for Ulcer*[18] R. de Vernejoul, E. Henry, and R. Devin, Professors of Surgery at the Faculty of Medicine of Marseille, France, present their experiences in a series of 3,000 cases of peptic ulcer.

The first chapter deals with the indications and selection of the patient for surgery. Next, the actual technique is illustrated. A statistical review, an analysis of complications, and late sequelae comprise the last chapter.

Clear, precise, experienced thinking characterize this volume. The fundamental principles of surgery are well emphasized. The expectant attitude in favor of a prolonged trial of medical treatment in a case of duodenal ulcer is replaced by an aggressive approach to the problem of an ulcer located on the small curvature of the stomach, a bleeding ulcer, or a perforation. Perhaps conservative surgery would be more appropriate in the management of an acute perforation.

[15] ATLAS OF GASTROENTEROLOGICAL CYTODIAGNOSIS. By Prof. Dr. med. N. Henning and Priv.-Doz. Dr. med. S. Witte. English translation by Dr. R. O. K. Schade. 103 pages, 114 illustrations, including 236 details. DM 38. Stuttgart: Georg Theime Verlag, 1957.

[16] TRAINING OF THE LOWER EXTREMITY AMPUTEE. By Donald Kerr, B.B.A., and Signe Brunnstrom, M.A. Introduction by T. Campbell Thompson, M.D. 272 pages, 153 illustrations. Springfield, Ill.: Charles C Thomas, 1956.

[17] PHOTOKOLPOSKOPIE UND PHOTODOUGLASSKOPIE INDIKATIONS UND TECHNIK. By Dr. Friedrich Menken. 76 pages, 90 illustrations. Wuppertal, Germany: Verlag W. Girardet, 1955.

[18] LA GASTRECTOMIE POUR ULCÈRE. By R. de Vernejoul, E. Henry, and R. Devin. 210 pages, 96 illustrations. 3,000 fr. Paris: Masson et Cie, 1956.

The various steps of a subtotal gastrectomy—Finsterer type—are illustrated in which the artist has shown exceptional talent and is to be congratulated. The comments that accompany these drawings point to the technical difficulties and the key-points of the operation. A surgeon would profit and learn from their suggestions in tackling difficult cases.

The differences between the authors' immediate postoperative care of the patient and that which we commonly see in this country attracted my attention. A Levin tube is rarely used, suction is occasionally instituted, and fluids by mouth are allowed on the day following surgery. Thus, fluid and electrolyte balance is not discussed. My first judgment, however, was tempered by the low mortality and morbidity rates. On the other hand, does suction itself add to the risks of the patients by causing disturbances in the fluids and electrolytes of the body?

A Finsterer type of retrocolic subtotal gastrectomy was performed in a great majority of the patients. It would have been more instructive if various techniques had been tried, attempting to fit the surgery to the patient rather than the other way around. Perhaps certain complications might have been avoided or lessened. A dogmatic teaching contributes less to human knowledge than a study with comparison and analysis.

This book is highly recommended to anybody interested in this field of surgery. —*Ara Doumanian.*

WRITTEN BY J. Caroli, in collaboration with several authors, *Les ictères par rétention*[19] is a complete diagnostic study of regurgitation jaundice. The many problems encountered in this interesting field are discussed. The author has had particular interest in the subject for 30 years, but has based the conclusions on a review of his last 500 cases.

In 60 to 70 per cent of the patients, the differential diagnosis between hepatocellular and the various causes of obstructive jaundice can be made from the history and physical examination. From the author's observations, 30 rules were formulated concerning the relative value of the different symptoms and signs. The greatest difficulty was encountered in cases of hepatitis simulating obstructive jaundice.

In the second chapter, liver function tests are evaluated and criticized. Then the advantage of preoperative radiologic studies is discussed. X-ray films of the right upper quadrant made before and after pneumoperitoneum are helpful. Information given by visualization of the duodenum with barium and of the splenic and portal veins by splenography is discussed in detail. The author also stresses the value of oral and particularly intravenous cholangiography after remission of jaundice and even during the icteric phase. Concerning this point, the bromsulphalein excretion is important. There is a good chance for visualization if not more than 30 per cent is retained after 45 minutes. Evidently, absence of visualization has no diagnostic value.

The author has had considerable experience with laparoscopy. The color of the liver, its gross appearance, its volume, and the state of the gallbladder enable him to differentiate between obstructive jaundice and hepatitis and to give a prognosis in the latter case.

Laparoscopy reveals dilated gallbladders which are not palpable. Color photographs are made and constitute valuable evidence. This method makes needle biopsy of the liver unnecessary. Cases in which the condition cannot be diagnosed grossly show a confusing microscopic picture, but the author studies the different microscopic lesions, none of them being pathognomonic by itself, and presents beautiful photomicrographs.

He has also used Royer's method of diagnosis consisting of a direct cholangiography obtained by injecting the dye into the gallbladder under laparoscopic control. The obstruction to the flow of bile can be located accurately. However, this method is dangerous and should be abandoned.

The last 3 chapters deal with operative cholangiography, its technique, and its results in calculous and neoplastic obstructions. It is a comprehensive study of the method with many excellent pictures.

In summary, the book is a valuable treatise on the differential diagnosis of jaundice. Report of cases as well as many beautiful pictures illustrate the discussion. —*Robert Cote.*

THE BOOK *Guide to Medical Writing*[20] is a natural outgrowth of the extensive experience of the author in medical writing and editing. The predominant concern throughout is to achieve clarity in the transmission of thoughts, ideas, and experiences through the medium of medical writing whether this be an article, abstract, a review, an editorial, or a book.

Segments are devoted to organization of the article from title to bibliography, to proper presentation of charts and graphs, to research methods, to punctuation, and to numerous other details too often forgotten or misunderstood. Numerous examples are used throughout to illustrate and emphasize the author's viewpoints.

The book has a direct yet readable style. Its value will be in its availability as a reference guide.

—*W. Harrison Mehn.*

THE VOLUME entitled *Clinical Use of Radioisotopes; a Manual of Technique*[21] by T. Fields and L. Seed is a superbly compact manual on the modern day concept and usage of radioactive materials in medicine. There are some 15 contributors to this little volume and it completely covers the field of isotope techniques. It contains excellent discussions of the various safety features and methods to be used in establishing a laboratory and is well illustrated. The requirements of the Atomic Energy Commission methods of therapy are divided into medical problems rather than by specific isotopes which makes for easy reading.

[19]LES ICTÈRES PAR RÉTENTION; DIAGNOSTIC MEDICO-CHIRURGICAL. By J. Caroli. In collaboration with A. Charbonnier, J. Étéve, A. Paraf, and P. Ricordeau. 481 pages, 308 illustrations. Paris: Masson & Cie, 1956.

[20]GUIDE TO MEDICAL WRITING; A PRACTICAL MANUAL FOR PHYSICIANS, DENTISTS, NURSES, PHARMACISTS. By Henry A. Davidson, M.D. 338 pages, illustrated. $5.00. New York: The Ronald Press Co., 1957.

[21]CLINICAL USE OF RADIOISOTOPES; A MANUAL OF TECHNIQUE. Edited by Theodore Fields, M.S., F.A.C.R. (Assoc.), and Lindon Seed, M.D. 455 pages, illustrated. $9.50. Chicago: The Year Book Publishers, Inc., 1957.

There are excellent chapters on radiation detection devices, as well as a chapter on the recommendations for radiation safety. The appendices contain a glossary of terms used in this newer field of medicine, as well as examples of decay, graphs, and charts with which to follow therapy in the hospital. There is also an excellent chapter on instructions for hospital personnel in the handling of these dangerous drugs.

I am sure that this volume is a necessity for both the experienced and the beginning physician interested in the field of isotope therapy. This book should be available to all physicians and hospitals that are closely connected with this field of therapy.

—J. E. Kearns.

A DETAILED STUDY of 9 patients operated upon during the neonatal period, summarizing over 3,500 chemical determinations done before and immediately following operation is presented in the volume entitled *The Metabolic Response to Neonatal Surgery*.[22] The text emphasizes quantitative analysis and represents an excellent attempt at exhaustive study of the biochemical and physiologic changes which occur in neonatal surgery.

In spite of the small number of patients analyzed, a prodigious amount of work was involved. The book, therefore, adds to the medical literature much needed information about the changes associated with neonatal surgery. It is also a good reference text for those interested in the subject and presents a detailed bibliography in this field.

There is one shortcoming which the author himself has emphasized. Because of the small number of cases involved, it is possible only to draw inferences and to point out tendencies. No definite conclusions regarding neonatal surgery can be made. The author, however, very ably summarizes some of the principles regarding surgical care of the newborn that he has adopted as a result of the observations which he made.

—Thomas G. Baffes.

THE SIXTH EDITION of *Gifford's Textbook of Ophthalmology*,[23] represents the third revision by Francis H. Adler. The continued popularity of this book may, in part, be attributed to the determined effort of Sanford Gifford to place emphasis on really important facts with little or none upon those which are unimportant. This original conception gave rise to a volume that was useful to both medical students and general practitioners.

The format of the book is very good, with subject and paragraph titles printed in bold-faced type. This makes the book easy to read. Some new and better illustrations have been added and certain subjects have been written in greater detail, such as the viral and degenerative diseases. The scattered references to ocular injuries have all been collected in a new chapter entitled "Ocular Injuries." The general physician will appreciate this as it lists the equipment needed and the surgical procedures which he can safely perform himself.

The many friends of this well known text will find in this new edition further proof that Francis H. Adler was a wise choice when he was selected as Gifford's successor.

—Irving Puntenney.

THE PUBLISHERS as well as Greenhill must have felt very secure in the adequacy of the first edition of *A Handbook of Operative Surgery*[24] because the second edition has been changed very little. This, as a matter of fact, is succinctly stated by the author in his preface to the second edition. Furthermore, out of some 8 to 10 new operations which have been included, at least half of them are definitely out of the precise field of gynecology. In a former review of the first edition of this valuable book most of the fault we were able to find, which was little enough, concerned the tendency to "lumpiness"—a certain unevenness in the material stressed, principally textual. So it is matter for mild surprise to find the author extending himself upon relatively unrelated material which is actually better and more exhaustively considered in easily available media elsewhere. On the other hand he has deleted 2 operations which were described in the former edition.

In its first edition, we did not find this book to be the best of Greenhill's many excellent commitments. His virtue here seemed to be rather more encyclopedic than specific. On the other hand, concerning his textual material we stated: "Here in pleasing contrast to the esoteric commitments of the mighty, we find needful material presented, . . . certainly with a clear eye to workaday needs."

In a considerable experience as a reviewer we have had the doubtful privilege of reviewing a number of so-called atlases or visual-aid compendia in gynecologic surgery and obstetrics. It is an innately difficult field from the point of view of the author and the publisher. Other towering figures in this field have been betrayed by it; but not Greenhill. From this point of view we dare again quote our original commitment: "Getting over now to the magnum opus, the illustrations are in general the best we have seen in pen and ink (zinc etching) technique. They are clear and lucid and leave no doubt in the observer's mind that they convey accurately the author's concept . . . The captions and operative directions (being of the essence) are as good as they could be. Here again it is our opinion that this rather vital department of the author's effort is well ahead of contemporary virtue in the same field."

We would repeat, then, the brunt of our critique involves the innate difficulty of a picture book medium. For this book, in particular, we have said, and repeat, it is "comparable in total value to any existent text in its precise field and superior to most in crude virtue of fidelity to the majority needs. It is certainly, for most of us, a lot of book for the price.

—Goodrich C. Schauffler.

[22] THE METABOLIC RESPONSE TO NEONATAL SURGERY. By P. P. Rickham, M.S. (London), F.R.C.S., D.C.H. 93 pages, illustrated. $5.00. Published for the Commonwealth Fund. Cambridge, Mass.: Harvard University Press, 1957.

[23] GIFFORD'S TEXTBOOK OF OPHTHALMOLOGY. By Francis Heed Adler, M.D. 6th ed. 499 pages, 277 illustrations and 26 colored plates. $8.00. Philadelphia and London: W. B. Saunders Co., 1957.

[24] A HANDBOOK OF OPERATIVE SURGERY: SURGICAL GYNECOLOGY; INCLUDING OBSTETRIC OPERATIONS. By J. P. Greenhill, M.D. Illustrated by Angela Bartenbach. 2nd ed. 377 pages, 107 illustrations. Chicago: The Year Book Publishers, Inc., 1957.

THE VOLUME of 316 pages, *Essentials of Clinical Proctology*,[25] is a valuable handbook for the student and especially for the busy general practitioner. It makes readily available a store of practical information that should aid the physician who includes such work in his practice. The illustrations are excellent.

The authors adhere to the English concept of "pectenosis." The explanation of this condition on a basis of chronic passive congestion seems a bit confusing, because the scientifically curious reader is likely to wonder what causes the passive congestion. The reviewer believes that there is steadily increasing evidence to support the thesis of anal infection as the chief cause of anorectal inflammatory disease, that spontaneous anal contracture is one manifestation of anal infection, and that such contracture and pectenosis are one and the same.

Since all the information in this volume is important it would be difficult to omit any of it. However, the reviewer wonders if the story pertaining to anorectal venereal disease could be shortened to provide space for more information concerning diverticulosis and diverticulitis of the colon.

—J. Peerman Nesselrod.

THE VOLUME entitled *Die boesartigen Geschwulste des Dickdarms und Mastdarms*[26] is one of a series of *Neue Deutsche Chirurgie* (Modern German Surgery) by Professor Dr. Nikolai Guleke, who is one of the senior surgeons in Germany. He was formerly Professor of Surgery at the University of Jena and is now living at Wiesbaden. His extensive surgical experience and intimate knowledge of this field for many years enable him to cover this extensive subject thoroughly and to discuss the pertinent questions very interestingly. Questionnaires were sent to all of the West German university clinics, so that the present state of colon and rectum surgery is truly reflected. Extensive references to the international literature are given.

Anatomy, physiology, and pathology are presented in detail. The pathogenesis of colonic and rectal cancer and the questions of cancer disposition and defensive mechanisms are discussed extensively. Symptoms, diagnosis, and differential diagnosis are dealt with next. The importance of early recognition of the disease is stressed. The author proposes to increase the medical education of the population, to enlarge the free cancer clinic program, and to make rectoscopy a routine procedure for all patients admitted to hospitals. Half of the book is devoted to a complete description of the various surgical procedures and their evaluation.

The author is of the opinion that anterior resection and sphincter preserving operations should be done only for lesions 10 centimeters or more above the anal margin, reasoning that the resection should include a length of bowel 5 centimeters below the lower tumor margin in order to avoid the possibility of retrograde lymphatic spread, which is suspected in about 2 to 4 per cent of the cases. Another 5 centimeters should be available for the anal mucosal stump to avoid damage to the sphincter apparatus. Only an exceptionally favorable lesion less than 10 centimeters distant from the anal margin should be treated by anterior resection. Otherwise one staged combined abdominoperineal or abdominosacral resection (amputation) is the method of choice. Credit is given to the excellent results of other procedures in the hands of experts.

The main object of the book is to present a sound and safe program in the diagnosis and management of colonic and rectal cancers and to indicate the available problems which have to be solved in the future.

—E. W. Ferbers.

A DETAILED REVIEW of the majority of surgical problems seen in infants and children is presented in *Lehrbuch der Kinderchirurgie*[27] by Max Grob and his associates. The 775 page book is well organized in a manner especially to the liking of students in that each subject is dealt with methodically and systematically. The pathologic anatomy, symptoms, x-ray findings, diagnosis, differential diagnosis, and treatment are briefly outlined and well illustrated with numerous photographs, black and colored reproductions of roentgenograms, and a few drawings of operative procedures.

The number of subjects discussed obviously makes it impossible in one volume to give more than the essential facts about any disease or deformity. The virtue of the book lies in the fact that any subject can be looked up rapidly. In this respect it is a good book for students and those who wish a quick and accurate review of basic facts.

Those who read German, but not too fluently, will be able to read this book without difficulty and with pleasure because it is simply written. The long flowing sentences so beloved by the Germans with the verb on the following page have been fortunately avoided.

The book is recommended for all who have a reading knowledge of German. Incidentally, the absence of references to the medical literature is possibly wise in that it makes the book less cumbersome.

—Willis J. Potts.

THE TENTH CONGRESS of the Belgian Surgical Society which convened in Brussels in 1956 devoted its entire program to the subject of posttraumatic osteoporosis. The resulting publication of more than 500 pages, entitled *L'ostéoporose posttraumatique*,[28] is composed of the 28 papers presented at the Congress by the leading European authorities in this field.

The report reviews in great detail our present knowledge of posttraumatic osteoporosis in all its aspects. It is well presented and the different disciplines, in as far as they bear upon the condition, are proportionately dealt with. The material is beautifully

[25]ESSENTIALS OF CLINICAL PROCTOLOGY. By Manuel G. Spiesman, M.D., B.S., LL.D., F.I.C.P., and Louis Malow, M.D., B.S., F.A.C.S. 3rd ed. 316 pages, 129 illustrations. $8.75. New York and London: Grune & Stratton, 1957.

[26]DIE BOESARTIGEN GESCHWULSTE DES DICKDARMS UND MASTDARMS. By Prof. Dr. Nicolai Guleke. 359 pages, 66 illustrations. DM 93.- . Stuttgart: Ferdinand Enke Verlag, 1957.

[27]LEHRBUCH DER KINDERCHIRURGIE. By Priv.-Doz. Dr. Max Grob, with the collaboration of Dr. Margrit Stockmann and Dr. Marcel Bettex. 775 pages, 876 illustrations. DM 157.-. Stuttgart: Georg Thieme Verlag, 1957.

[28]L'OSTÉOPOROSE POSTTRAUMATIQUE. Edited by Alfred Dumont and A. Walch. Acta Chirurgica Belgica et Acta Orthopaedica Belgica. Supplement I. Rapports présentés au Dixième Congrès Belge de Chirurgie. 524 pages, illustrated. Bruxelles: Acta Medica Belgica, 1956.

illustrated by numerous roentgenograms and photographs of pathologic specimens and microscopic sections.

A certain amount of repetition and overlapping is inevitable at a surgical congress, particularly when there is only one topic under discussion, and the faults in the report as a whole can be forgiven on this basis, but verboseness and unnecessary reiteration in individual articles is less excusable. In most instances, the contents could have been considerably condensed without losing any of their value, and at the same time adding to their readability.

The general introduction consists of a lengthy dissertation on the disease as a whole; and then considers the chronologic history, the different theories pertaining to etiology, and the medicolegal considerations which the disease involves. Concerning the latter, the opinion is held that, irrespective of the causes contributing to the appearance of posttraumatic osteoporosis, the condition merits insurance compensation.

The various contributions are arranged in sections dealing with the various aspects of the disease, including biochemical, histopathologic, physiopathologic, and experimental considerations; the roentgenographic appearances; the clinical symptomatology; and therapeutic methods, both preventive and curative.

The section on the biochemistry and histopathology of osteoporosis covers the entire problem of bone metabolism. The detailed scientific account includes studies of complicated protein determinations and investigations using radioactive isotopes.

There are two experimental contributions, one from the Nuffield Orthopedic Center at Oxford University, and the second from the René Leriche Laboratories at Strasbourg University. The former comprises a study of the comparative osteology of the rabbit, ape, Neanderthal man, and the present species of Homo sapiens with particular reference to the thickness and anatomic architecture of bones resulting from the pressure and stress imposed by different types of posture. The group has also studied the vascularization of bone under different conditions. They have found that contrary to expectation the rarefaction of bone diagnosed by x-ray examination is accompanied by increased vascularization both in the caliber and number of vessels in the affected zone.

The Strasbourg group describe the oxygen consumption of the tissues after injury. Using the contralateral normal limb as a control, the investigators determined that immediately after injury there is an increase in oxygen consumption; this is followed by a slight decrease during the first 8 to 16 hours after injury, and then a secondary increase and final equalization with the normal limb after 4 or 5 days.

In a series of experiments on laboratory animals these investigators have also found that metabolic changes, involving particularly calcium and phosphorus, in bones showing radiologic evidence of osteoporosis occur also in the surroundihg tissues, muscles, tendons, and skin.

The presentation deserving particular mention is that from the Accident and Traumatic Center in Brussels. Some 150,000 patients with every degree and variation of injury were reviewed together with a discussion on the prevention and management of possible complications of which osteoporosis constitutes a major problem.

This volume should be of interest to the orthopedist and those surgeons dealing with traumatic injuries. It is the most complete review of the subject to date, and contains an extensive bibliography.

—*Peter Beaconsfield.*

THE AUTHORS have presented most of the endocrinologic disturbances presently known to man in their *Atlas of Clinical Endocrinology*.[29] Most of the disorders are illustrated by pictorial and graphic examples of their own patients, as well as those culled from the literature; the latter may be of historic interest to the reader. Also included in each of the diseases are case reports, an outline of signs, symptoms, and laboratory findings arranged in the order of their importance for adequate diagnosis, notes on therapy, and a list of references to the literature. The pictures, reproductions, and photomicrographs are well selected, and the format and the binding are excellent.

The purpose of the book as conceived by the authors, i.e., to offer a concise and visual presentation of endocrine disorders in atlas format, with a short text on diagnosis and therapy, is adequately accomplished. This atlas should prove to be a valuable adjunct to the standard textbooks on endocrinology for the student and physician. —*Mark C. Wheelock.*

THIRTY-THREE TEACHERS of surgery from a number of German and Swiss surgical clinics have contributed to the textbook, *Lehrbuch der Chirurgie*,[30] under the editorship of H. Hellner, R. Nissen, and K. Vossschulte. The material is conventionally organized; it begins with a consideration of wound healing and wound management and proceeds to the subjects of hemorrhage, blood coagulation, transfusions, infections, cardioisotopes in surgery, shock, thrombosis and embolism, anesthesia, plastic surgery (including tissue transplantation), and details of operating room procedures. There is an excellent chapter on the pathologic physiology of the surgical patient which includes a thorough discussion of fluid and electrolyte balance. Following are chapters dealing with the various regions of the body, beginning with neurosurgery and including head and neck, thoracic, abdominal, urologic, and orthopedic surgery. In true Germanic tradition, gynecology is not included in this general surgical textbook.

The discussions are uniformly complete yet excess verbosity has been avoided. Many of the chapters are introduced by a brief historical note. There are numerous well chosen photographs and a special feature are the many excellent charts, diagrams, and schematic illustrations. Mention may even be made of the three stanza poem written by Theodor Storms, himself a victim of carcinoma of the stomach and

[29] ATLAS OF CLINICAL ENDOCRINOLOGY; INCLUDING TEXT OF DIAGNOSIS AND TREATMENT. By H. Lisser, A.B., M.D., and Roberto F. Escamilla, A.B., M.D. 476 pages, 148 illustrations including 3 in color. $18.75. St. Louis: The C. V. Mosby Co., 1957.

[30] LEHRBUCH DER CHIRURGIE. By Prof. Dr. H. Hellner, Prof. Dr. R. Nissen, and Prof. Dr. K. Vossschulte. 1060 pages, 596 illustrations. DM 84. - . Stuttgart: Georg Thieme Verlag, 1957.

describing his own reactions. The title of the poem is "Beginning of the End."

While seemingly directed to students and younger men in training as surgeons, the text could, nevertheless, be read with much profit by general surgeons who desire a review of the whole field and related specialties. This, of course, would apply essentially to German speaking surgeons. In this age when American physicians no longer attend German and Austrian Clinics for postgraduate instruction, it is unlikely that much interest in a book such as this will be evinced in the United States. It may be highly recommended, however, to any surgeon who wishes to "kill two birds with one stone," i.e., practice reading German and at the same time review general surgery and learn the German point of view. The large majority of references at the end of each chapter are to the German literature.

The tome itself is ponderous, due to heavy binding, high quality paper, and its 1059 pages. The type is large and easily read. The publication is in the highest tradition of excellence that characterized German medical books in the many decades before the last world war. —*Alexander Brunschwig.*

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Pseudarthrose congénitale du tibia et son traitement. By M. Guilleminet and R. Ricard. 98 pages, 78 illustrations. 1.800 fr. Paris: Masson & Cie, 1958.

Pathologie vasculaire des membres. By Pierre Wertheimer and J. Sautot, with the collaboration of J. Favre-Gilly and A. Lapras. 406 pages, 59 illustrations. 4.000 fr. Paris: Masson et Cie, 1958.

Urgences vasculaires des membres. By Jean Lamy and Christian Bourde. Préface by Pr. R. De Vernejoul. 318 pages, 109 illustrations. 3.600 fr. Paris: Masson et Cie, 1957.

Oral Surgery. By Kurt H. Thoma, D.M.D., F.D.S., R.C.S.(Eng.), F.A.C.D. 3rd ed. 1607 pages, 1824 illustrations, 159 in color. $27.50. St. Louis: C. V. Mosby Co., 1958.

Collection de chirurgie orthopédique. Traumatismes anciens généralitiés membre supérieur. By R. Merle D'Aubigné and R. Tubiana, with the collaboration of 8 others. 441 pages, 215 illustrations. Paris: Masson et Cie, 1958.

Intestinal Obstruction. By Claude E. Welch, M.D. Illustrated by Muriel McLatchie Miller. 376 pages. $10.50. Chicago: The Year Book Publishers, Inc., 1958.

Modern Medical Monographs Edited by Irving S. Wright and Richard H. Orr. The Medical Management of Cancer. By Henry D. Diamond, M.D., F.A.C.P. 179 pages, illustrated. $6.75. New York and London: Grune & Stratton, Inc., 1958.

Psychoprophylactic Preparation for Painless Childbirth; its Theory and Practical Approach with the Complete Course of Lectures. By Isidore Bonstein, M.D. 143 pages, illustrated. $2.50. New York and London: Grune & Stratton, Inc., 1958.

Functional Bracing of the Upper Extremities. By Miles H. Anderson, Ed.D. Edited by Raymond E. Sollars. 463 pages, illustrated. $9.50. Springfield, Ill.: Charles C Thomas, 1958.

Anomalies of Intestinal Rotation and Fixation (Including Mesentericoparietal Hernias). By Roberto L. Estrada, M.D., F.A.C.S. 161 pages, illustrated. $6.50. Springfield, Ill.: Charles C Thomas, 1958.

Pathophysiologische Grundlagen der Chirurgie in ihrer Auswirkung auf chirurgisches Handeln. By Priv. Doz. Dr. Med. Th. Otto Lindenschmidt. Introduction by Prof. Dr. L. Zukschwerdt. 410 pages, illustrated. $13.25. Stuttgart: Georg Thieme, 1958.

Die Roentgenuntersuchung der Harnorgane. By Dr. Med. O. Kneise and Dr. Med. K. L. Schober. With the assistance of Dr. Med. U. Schneider. Rev. ed. 328 pages, illustrated. geb.DM 55. Leipzig: Veb Georg Thieme, 1958.

Care of the Premature Infant. By Evelyn C. Lundeen, R.N., and Ralph H. Kunstadter, M.D., F.A.C.P., F.A.A.P. 367 pages, 87 illustrations. $8.00. Philadelphia and Montreal: J. B. Lippincott Co., 1958.

Pediatric Gynecology: with Sections on Urology and Proctology. By Goodrich C. Schauffler, M.D., 4th ed. 349 pages, illustrated. Chicago: The Year Book Publishers, Inc., 1958.

Pregnancy, Birth and Abortion. By Paul H. Gebhard, Wardell B. Pomeroy, Clyde E. Martin, and Cornelia V. Christenson of the Institute for Sex Research, Inc. 282 pages, not illustrated $6.00. New York: Harper & Bros., Publishers and Paul B. Hoeber, Inc., Medical Books, 1958.

Université Catholique de Louvain Laboratoire de Thérapeutique Expérimental. Professeur A. Simonart. L'auto-intoxication après brûlure. By T. Godfraind. 191 pages, illustrated. Bruxelles: Éditions Arscia S. A., 1958.

Modern Trends in Gastro-Enterology. 2nd series. Edited by F. Avery Jones, M.D., F.R.C.P. 439 pages, illustrated. $16.00. New York: Paul B. Hoeber, Inc., Medical Book Department of Harper & Bros., 1958.

Clinical Enzymology. Edited by Gustav J. Martin, Sc.D. 241 pages, illustrated. $6.00. Boston and Toronto: Little, Brown & Co., 1958.

Regional Ileitis. By Burrill B. Crohn, M.D., and Harry Yarnis, M.D. With special contributions by Richard H. Marshak, M.D., and David A. Turner, Ph.D. 2nd rev. ed. 239 pages, illustrated. $7.25. New York and London: Grune & Stratton, 1958.

Textbook of Obstetrics and Obstetric Nursing. By Mae M. Bookmiller, R.N., and George Loveridge Bowen, A.B., M.D. 3rd ed. 725 pages, illustrated. Philadelphia and London: W. B. Saunders Co., 1958.

Bases physio-biologiques et principes généraux de réanimation. By H. Laborit. With the collaboration of M. Cara, D. Jouasset, G. Duchesne, and G. Laborit. 273 pages, illustrated. 2.600 fr. Paris: Masson & Cie, 1958.

AMERICAN COLLEGE OF SURGEONS

WILLIAM L. ESTES, JR., Bethlehem, Pennsylvania, *President*

NEWELL W. PHILPOTT, Montreal, Quebec, Canada, *President-Elect*

PRELIMINARY PLANS FOR THE 44th CLINICAL CONGRESS THE CONRAD HILTON HOTEL, CHICAGO, ILLINOIS OCTOBER 6 TO 10, 1958

THE SECOND Baxter Lecture will be presented this year by the eminent Gunnar Thorsen on Wednesday at 2 p.m. This lectureship in the field of parenteral fluid therapy is supported by annual grants to the College from Baxter Laboratories of Morton Grove, Illinois.

Dr. Thorsen, surgeon to outpatients and Assistant Professor of Surgery at Serafimer Lasarettet, Stockholm, has written numerous articles on the use of dextran, including "Dextran as a Plasma Substitute," "Resuscitative Effect of Dextran *p*H After a Large Hemorrhage," and "Influence of Dextran *p*H on Tensile Strength of Healing Wounds."

General Sessions

General sessions will begin promptly at 10 a.m. Monday. President William L. Estes, Jr. will preside over the opening panel on "Emergencies in Postoperative Care," with Richard L. Varco as moderator and, as collaborators, Eugene L. Bricker, Ben Eiseman, and Allan D. McKenzie.

From 1:30 to 3 p.m. the topic will be "Peripheral Arterial Disease," with Oscar Creech, Jr. as moderator and, as collaborators, Wiley F. Barker, Ralph A. Deterling, Jr., and J. C. Luke. A panel discussion will follow on "Intestinal Obstruction." Rudolf J. Noer will moderate, and the collaborators will be Robert E. Gross, Charles G. Johnston, Champ Lyons, and Owen H. Wangensteen.

"Surgery of Pelvic Cancer," is the topic Tuesday at 1:30 p.m. Herbert E. Schmitz is the moderator, and the collaborators are Justin J. Cordonnier, Waring G. Cosbie, Milton L. McCall, and Langdon Parsons. "Surgery of Duodenal Ulcer" will follow, with moderator Edward Starr Judd, Jr., and collaborators Joel W. Baker, Robert C. Harrison, and Robert M. Zollinger.

Symposium on Trauma

The Symposium on Trauma will be held Tuesday at 2 p.m. Preston A. Wade, Chairman of the Committee on Trauma, will preside. Topics and speakers follow:

Trauma in Childhood. C. EVERETT KOOP.

Postoperative Care of the Multiple Injury Patient. WAYNE W. GLAS.

The Problem of the Speeding Ambulance. SYDNEY N. LYTTLE.

Present Status and Complications of Operative Treatment of Fractures. EDWIN F. CAVE.

Observations in Vascular Dynamics During Hemorrhagic Shock. HERBERT J. ROBB.

On Wednesday at 1:30 p.m. "Injuries of the Hand" will be the subject, with Joseph H. Boyes, moderator, and J. Edward Flynn, Stuart Douglas Gordon, and Vinton E. Siler collaborating. A discussion on "The Intervertebral Disc" will follow, with moderator James K. Stack, and collaborators Frank H. Mayfield, John Raaf, Alexander P. Aitken, and Mark B. Coventry.

Symposium on Cancer

The Symposium on Cancer will be held Wednesday at 2:45 p.m. Danely P. Slaughter,

Chairman of the Committee on Cancer, will preside. Topics and speakers follow:

Management of the Patient with Positive Vaginal Cell Examination. JOE V. MEIGS.

Current Status of Diagnosis and Treatment of Lung Cancer. O. THERON CLAGETT.

Current Status of Diagnosis and Treatment of Prostate Cancer. VINCENT J. O'CONOR.

Present Status of Diagnosis and Treatment of Stomach Cancer. JAMES T. PRIESTLEY.

On Thursday at 1:30 p.m. "Surgical Shock" will be discussed by Fraser N. Gurd, moderator, and John M. Howard, Francis D. Moore, and Robert H. Kennedy, collaborators.

The Oration on Trauma will follow, from 3 to 3:30 p.m.

"What's New in Surgery?" the résumé of Forum sessions will be heard Friday morning from 9 a.m. to 12 noon, Harris B. Shumacker, Jr. presiding.

Specialty Sessions

An advance outline of the specialty sessions follows:

GYNECOLOGY AND OBSTETRICS

MONDAY, 1:30–3 p.m.—Prevention of Abortion by Surgical Procedures. ROBERT H. BARTER, Moderator. Collaborators: BERNARD J. PISANI, H. L. RIVA, WILLIAM B. STROMME. 3:30–5 p.m.— Indications for Hysterectomy. WALTER T. DANNREUTHER, Moderator. Collaborators: LEROY A. CALKINS, MICHAEL J. JORDAN, NORMAN F. MILLER, E. STEWART TAYLOR.

TUESDAY, 1:30–3 p.m.—Obstetrical Anesthesia and Analgesia. RALPH A. REIS, Moderator. Collaborators: WILLIS E. BROWN, CHARLES S. STEVENSON, H. HUDNALL WARE, JR. 3:30–5 p.m.—Lymphatic Pathways of Pelvic Cancer. JOE V. MEIGS, Moderator. Collaborators: BAYARD CARTER, JOHN B. GRAHAM, LANGDON PARSONS.

WEDNESDAY, 1:30–3 p.m.—Indications for and Selection of Forceps for Obstetrical Deliveries. FRANK R. LOCK, Moderator. Collaborators: EDWARD H. DENNEN, FRANK O. KALTREIDER, JR., GEORGE B. MAUGHAN. 3:30–5 p.m.—Use of the Progesterone Synthetics. JOHN ROCK, Moderator. Collaborators: CELSO-RAMÓN GARCÍA, CARL G. W. HELLER, EMIL G. HOLSTROM, RICHARD L. LANDAU.

THURSDAY,—Surgical Forum session for gynecology and obstetrics.

FRIDAY, 8:30–11:30 a.m.—Symposium. M. EDWARD DAVIS. 1:30–3 p.m.—Current Knowledge of Causes of Congenital Anomalies. ROBERT E. L. NESBIT, JR., Moderator. Collaborators: THEODORE H. INGALLS, PETER GRUENWALD, SCHUYLER G. KOHL. 3:15–4:45 p.m.—The Gynecologist's Responsibility for Diagnosis of Rectal and Bladder Lesions. FRANKLIN L. PAYNE, Moderator. Collaborators: WILLIAM L. VALK, CLAUDE E. WELCH, JOHN H. RIDLEY, ROGER B. SCOTT.

NEUROLOGIC SURGERY

FRIDAY, 9–10:30 a.m.—Neurosurgical Problems in Cerebral Palsy. RUSSEL MEYERS, Moderator. Collaborators: IRVING S. COOPER, LYLE A. FRENCH, WINTHROP M. PHELPS, A. EARL WALKER. 10:35 a.m.-12:00 noon—Metastatic Tumors of the Nervous System. BRONSON S. RAY, Moderator. Collaborators: EBEN ALEXANDER, JR., JOSEPH P. EVANS, HERBERT PARSONS. 2–5 p.m.—Neurological Surgery Symposium. EDGAR F. FINCHER, presiding. Brain Abscesses. H. THOMAS BALLANTINE. Lathyrism and Allied Subjects. Speaker to be announced. Management of Cervical Injuries. W. GAYLE CRUTCHFIELD. Present Evaluation of the Decompression of the Sensory Root in the Treatment of Trigeminal Neuralgia. W. JAMES GARDNER. Technique and Results of High Cervical Chordotomy, HENRY G. SCHWARTZ.

ORTHOPEDIC SURGERY

FRIDAY, 1:30–3 p.m.—Fractures of the Elbow in Children and Adults. T. CAMPBELL THOMPSON, Moderator. Collaborators: JOHN J. FAHEY, ROBERT A. KNIGHT, WALTER P. BLOUNT. 3:15–4:45 p.m.—Management of Open Fractures. FRANCIS J. COX, Moderator. Collaborators: JOSEPH R. SHAEFFER, JAMES D. HARDY, FRED C. REYNOLDS, BENJAMIN E. OBLETZ.

PLASTIC SURGERY

MONDAY, 1:30–3 p.m.—Further Experiences in Tissue Transplantation. SUMNER L. KOCH, Moderator. Collaborators: W. A. ALTEMEIER, R. E. BILLINGHAM, MINOT P. FRYER, GEORGE W. HYATT. 3:30–5 p.m.—Plastic Surgical Aspects of Trauma. MILTON T. EDGERTON, JR., Moderator. Collaborators: JOHN L. BELL, S. MILTON DUPERTUIS, HAL B. JENNINGS, JR.

THORACIC SURGERY

FRIDAY, 1:30–3 p.m.—The Problem of Infections. H. ROCKE ROBERTSON, Moderator. Collaborators: W. A. ALTEMEIER, CHESTER W. HOWE, W. H. SUTHERLAND. 3:15–4:45 p.m.—Recent Advances in Cardiovascular Surgery. DONALD B. EFFLER, Moderator. Collaborators: HENRY T. BAHNSON, ALFRED W. HUMPHRIES, JOHN W. KIRKLAND, C. WALTON LILLEHEI.

UROLOGY

MONDAY, 1:30–3 p.m.—Methods of Approach in the Surgery of the Kidney and Adrenals. VICTOR F. MARSHALL, Moderator. Collaborators: JAMES M. CAMPBELL, RICHARD CHUTE, HARRY M. SPENCE.

TUESDAY, 3:30–5 p.m.—Diagnosis and Treatment of Testicular Tumors. JOHN A. TAYLOR, Moderator.

WEDNESDAY, 1:30–3 p.m.—Surgical Management of Urolithiasis. FRANK HINMAN, JR., Moderator. Collaborators: MILO ELLIK, LESTER PERSKY, PETER L. SCARDINO.

THURSDAY,—Surgical Forum session for urology.
FRIDAY, 1:30–3 p.m.—Management of the Neurogenic Bladder. GEORGE C. PRATHER, Moderator. Collaborators: ERNEST BORS, HERBERT S. TALBOT, FRANK C. HAMM, DONALD R. SMITH.

OPHTHALMOLOGY-EVENING SESSION

WEDNESDAY, 8 p.m.—Recent Developments in Ophthalmic Surgery. Moderator, WILLIAM B. CLARK. Collaborators: F. BRUCE FRALICK, LÓRAND V. JOHNSON, R. TOWNLEY PATON, ALBERT D. RUEDEMANN.

OTOLARYNGOLOGY-EVENING SESSION

WEDNESDAY, 8 p.m.—Temporal Bone Surgery. VICTOR GOODHILL, Moderator. Collaborators: J. H. THOMAS RAMBO, ROBERT HENNER, EUGENE L. DERLACKI, ARTHUR L. JUERS, THEODORE E. WALSH.

Postgraduate Courses

Courses, chairmen, and time are as follows: Details of the courses will be listed in a future issue of this Journal.

Preoperative and Postoperative Care. DAVID V. HABIF, New York. (Tuesday through Friday, 8:30–11:30 a.m.)
Gastrointestinal Tract. JOHN M. WAUGH, Rochester, Minnesota. (Tuesday through Friday, 8:30–11:30 a.m.)
Diseases of the Liver, Biliary Tract, and Pancreas. WILLIAM D. HOLDEN, Cleveland. (Tuesday through Friday, 8:30–11:30 a.m.)
Cardiovascular Surgery. ORMAND C. JULIAN, Chicago. (Tuesday through Friday, 8:30–11:30 a.m.)
Complex, Complicated, and Combined Injuries. OSCAR P. HAMPTON, JR., St. Louis, (Tuesday through Friday, 8:30–11:30 a.m.)
Gynecology and Obstetrics. M. EDWARD DAVIS, Chicago. (Monday through Thursday, 8:30–11:30 a.m.)
Injuries and Other Disabilities of the Hip. HAROLD A. SOFIELD, Oak Park. (Tuesday through Friday, 8:30–11:30 a.m.)
Surgical Aspects of Pulmonary Disease. EDWARD M. KENT, Pittsburgh. (Monday through Thursday, 1:30–4:30 p.m.)
Problems in Pediatric Surgery. WILLIS J. POTTS, Chicago. (Tuesday through Friday, 8:30–11:30 a.m.)

Nominal fee is $5.00. Because these courses are so popular, and seating will be limited to ticket holders, it is advisable to register as soon as possible.

Forum on Fundamental Surgical Problems

The complete list of Forum reports will appear in the September issue of this Journal. During the week, reports will be made on the latest research and new thinking in surgical techniques. The specialties of Gynecology and Obstetrics, Orthopedic Surgery, Plastic Surgery, Neurologic Surgery, and Urology will be included in this Forum. Reports are evaluated by Harris B. Shumacker, Chairman, and the Forum Committee, consisting of the following fellows:

J. GARROTT ALLEN, Chicago
ALLAN C. BARNES, Cleveland
CRAWFORD J. CAMPBELL, Albany
BRADFORD CANNON, Boston
WARREN H. COLE, Chicago
CLARENCE DENNIS, Brooklyn
ROBERT E. GROSS, Boston
JAMES D. HARDY, Jackson, Mississippi
HUGH J. JEWETT, Baltimore
C. HUNTER SHELDEN, Pasadena
SOMERS H. STURGIS, Boston

Color Television

Dr. Walter W. Carroll, local television chairman, and Dr. J. Garrott Allen, national television chairman, are in charge of these color telecasts originating from The Passavant Memorial Hospital. Procedures and operating surgeons, panel members, and moderators will be listed in a forthcoming issue. Smith, Kline & French Laboratories are the producers of these famous telecasts.

Motion Pictures and Ciné Clinics

As in past Congresses, new medical Motion Pictures and Ciné Clinics will be presented during the week. Establishment of the College Motion Picture Library and attentive audiences at recent programs have stimulated unusual interest in submitting a wide selection of good teaching films dealing with general surgery and many of the surgical specialties. Details of this program will appear shortly.

The noted Ciné Clinics films are again sponsored by the Surgical Products Division of American Cyanamid Company. All films are in color and narrated by the author. A preliminary program follows:

MONDAY

Anomalies of the Heart. GEORGE H. HUMPHREYS II.
Open Heart Surgery. WILLIAM H. MULLER, JR.
Intra-atrial Septal Defects. F. JOHN LEWIS.
Median Sternotomy and Elective Cardiac Arrest in Open Heart Surgery. FRANK L. GERBODE.
Pericardiectomy. HARRIS B. SHUMACKER, JR.
Coronary Endarterectomy. WILLIAM P. LONGMIRE, JR.
Occlusive Disease of Aorta. MICHAEL E. DEBAKEY.

TUESDAY

Neglected Surgical Lesions. HUGH E. STEPHENSON, JR.

Acute Gallbladder Disease. ALLEN M. BOYDEN.
Femoral Hernia. CLARENCE DENNIS.
Staphylococcal Infections in Surgery. H. ROCKE ROBERTSON.
Fibroids of the Uterus. WILLARD H. PARSONS.
Gastrectomy. SIR DIGBY CHAMBERLAIN.

WEDNESDAY

Meconium Ileus. DONALD M. GLOVER.
Surgical Lesions of the Intestine. RUDOLF J. NOER.
Film Panel on Surgery of the Large Intestine:
Carcinoma of the Colon. JOHN M. WAUGH.
Volvulus. HARWELL WILSON.
Ulcerative Colitis. HOWARD A. PATTERSON.
Diverticulitis. R. KENNEDY GILCHRIST.
Familial Polyposis. WALTER G. MADDOCK.
Perforating Carcinoma of the Cecum. WARREN H. COLE.
Polyps of the Colon. WILLIAM D. HOLDEN.

THURSDAY

Myasthenia Gravis; Diagnosis and Treatment by Thymectomy. MERLE M. MUSSELMAN.
Splenectomy. FRANK F. ALLBRITTEN, JR.
Hernia Repair with Mesh. JOHN R. PAINE.
Carcinoma of the Vulva. HOWARD ULFELDER.
Gastrectomy. WALTMAN WALTERS.
Thyroidectomy. RICHARD B. CATTELL.

Medical Student Program

Students from 37 medical colleges will attend this year's Congress, at College expense. This medical student participation program was initiated as an educational contribution of the College, by action of the Board of Regents, 3 years ago. The medical colleges sending representatives to the Congresses are rotated each year. and the students are selected by their classmates.

The students will attend a number of special sessions in addition to regularly scheduled lectures, discussions, motion picture demonstrations, and televised clinics covering all phases of surgical practice and research. This program was planned by a special committee of the College Board of Regents headed by Dr. George V. Brindley of Temple, Texas. Students attending past Congresses have reported that participation in this meeting has been an unforgettable and invaluable educational experience.

Advance Registration

Clinical Congress forms for advance registration, hotel accommodations, postgraduate courses, and transportation have already been sent to Fellows of the College. Non-Fellows may obtain these forms by writing to the American College of Surgeons, 40 East Erie Street, Chicago 11, Illinois. Early return of these forms is advisable to assure prompt receipt of your badge on your arrival, early choice of postgraduate courses, and satisfactory hotel accommodations.

Fees

Fellows whose dues are paid to December 31, 1957, pay no registration fee; those whose dues are not paid up to date pay $20.00. Non-Fellows pay $20.00; members of the Federal Services, $10.00. No fee is required of surgical residents, provided a note of identification signed by their chief of surgery or hospital administrator accompanies the registration form. No fee is required of Initiates or members of the Candidate group. The nominal registration fee for the postgraduate course, $5.00, is payable by everyone taking a course.

Registration Hours

Registration hours at The Conrad Hilton will be:

SUNDAY, October 5, 3 p.m. to 7:30 p.m.
MONDAY, October 6, 8 a.m. to 5:30 p.m.
TUESDAY through FRIDAY, 8 a.m. to 5 p.m.

Ladies Entertainment

The Ladies Entertainment Committee cordially invites doctors' wives to come to this meeting. A full week of interest and recreation has been planned for the ladies.